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REGULATORY REQUIREMENTS IMPORTANT TO HANFORD SINGLE-SHELL TANK WASTE MANAGEMENT DECISIONS

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January 1989

Prepared for
the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

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EXECUTIVE SUMMARY

This report provides an initial analysis of the regulations that may be pertinent to SST management activities (e.g., characterization, disposal, retrieval, processing, etc.) and the interrelationships among those regulations. Waste disposal decisions regarding SST waste must consider the regulatory requirements that impose constraints on technical solutions. Regulatory requirements can also be used as guidelines for management and disposal of waste in a manner that protects human health and safety and the environment. Also, in cases where waste management regulations do not specifically address a waste form, such as radioactive mixed waste, the SST waste may come under the purview of a number of regulations related to radioactive waste management, hazardous waste management, and water and air quality protection. This report provides a comprehensive review of the environmental pollution control and radioactive waste management statutes and regulations that are relevant to SST waste characterization and management. Also, other statutes and regulations that may contain technical standards that may be used in the absence of directly applicable regulations are analyzed.

This analysis of regulations applicable to management and disposal of SST waste identified the following three areas where requirements and criteria must be met: 1) performance, 2) design, and 3) permits. The requirements and criteria imposed by pertinent regulations in these three areas must be considered in 1) evaluating SST waste management options and 2) designing an efficient waste characterization scheme that provides the information necessary to make this evaluation. The design and performance requirements are important in technology development and selection, performance assessments, and waste characterization efforts. The permits may also specify design and performance criteria. The performance, design, and permit criteria approach provides a framework that integrates the various requirements discussed in this report into a form that is useful to both decision-makers and disposal system designers.

CONCLUSIONS

Based on the review and analysis undertaken in this study, the following conclusions were reached:

- Many key issues important to SST waste management decisions have not yet been resolved. These issues involve waste definitions and classifications, radioactive mixed waste disposal, and groundwater protection requirements.
- Many of the current federal and state statutes and regulations, such as the Resource Conservation and Recovery Act (RCRA), specify general requirements without providing sufficient quantitative criteria to assess the performance of the proposed disposal systems. In the absence of such quantitative criteria, regulations other than the RCRA must be turned to in order to evaluate compliance with generic requirements for environmental protection.
- While regulations specific to radioactive mixed waste disposal have not been promulgated, several radioactive waste management and radiation protection standards for radioactive waste disposal systems and other operations are repeated throughout the regulations.
- The most significant design requirements identified in this report are the RCRA requirements for closure and postclosure care of a tank system, which include requirements for removing or decontaminating all waste residues, contaminated system components, and contaminated soils.
- Variances from the RCRA tank system regulations for tank integrity, secondary containment, response to leaks or spills, and some closure and postclosure requirements may need to be obtained.
- Even though the exact contents and concentrations of wastes in the SSTs are uncertain, example calculations that average suspected constituent inventories over the entire SST waste volume can be used to identify the constituents that will be of particular regulatory concern.
- Groundwater protection will be one of the most important factors in determining whether in-place disposal of the SST wastes will be acceptable to the regulatory agencies.
- Regulations, other than RCRA, contain quantitative criteria that can be used as guidance in assuring that groundwater protection is appropriately considered.

The implications of these conclusions for SST waste characterization and disposal are discussed in more detail in the report.

RECOMMENDATIONS

Recommendations that address the implications of these conclusions are briefly described below.

- Regulatory requirements will be important and should be addressed throughout the SST waste management and disposal program.
- Tracking of the evolving regulatory regime for radioactive mixed waste should be an integral part of waste management planning. For example, because of the unique nature of the SST mixed wastes, evolving RCRA requirements should be reviewed for their applicability and relevance to SST management.
- In areas that the RCRA regulations do not provide specific criteria, "substitute" numerical criteria may be used to compare with results of performance assessments for in-place disposal systems. These criteria should be based on regulations that specify numerical criteria in these areas.
- As SST wastes are further characterized, the discussion on the statutes, regulations, and guidance in this report should be developed further to determine their applicability to the SSTs, and the detailed requirements impacting various waste constituents found to be present should be integrated into the waste management decision-making process.

Detailed discussion of these recommendations is provided in the report.

CONTENTS

FIGURES

TABLE

ACRONYMS

ACL	alternate concentration limit
AEA	Atomic Energy Act of 1954, as amended
ALARA	as low as is reasonably achievable
ANPR	advanced notice of proposed rulemaking
BARCT	best available radionuclide control technology
BRC	below regulatory concern
CAA	Clean Air Act (federal)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act, as amended
CFR	Code of Federal Regulations
CWA	Clean Water Act (federal), as amended
DSHS	(Washington State) Department of Social and Health Services
DOE	U.S. Department of Energy
DW	dangerous waste
Ecology	Washington Department of Ecology
EHW	extremely hazardous waste
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ERA	Energy Reorganization Act of 1974
FR	Federal Register
FWPCA	Federal Water Pollution Control Act, as amended
GCD	greater confinement disposal
GTCC	greater than Class C (waste)

HDW-EIS	Final Environmental Impact Statement for the Disposal of Hanford Defense High-Level, Transuranic, and Tank Wastes (DOE/EIS-0113)
HLW	high-level radioactive waste
HWM	hazardous waste management
ICRP	International Commission on Radiological Protection
LLRWPAA	Low-Level Radioactive Waste Policy Amendments Act
LLW	low-level radioactive waste
LLWPA	Low-Level Radioactive Waste Policy Act of 1985
MCL	maximum contaminant level
NARM	naturally-occurring and accelerator produced radioactive material
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NPDWR	national primary drinking water regulations
NPR	notice of proposed rulemaking
NRC	U.S. Nuclear Regulatory Commission
NWPA	Nuclear Waste Policy Act of 1982, as amended
OSHA	occupational safety and health
PCB	polychlorinated biphenyl
PSD	prevention of significant deterioration
RACT	reasonably available control technology
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RQ	reportable quantity

SARA	Superfund Amendments and Reauthorization Act
SEPA	State Environmental Policy Act
SDWA	Safe Drinking Water Act (federal)
SST	single-shell tank
TPQ	threshold planning quantity
TRU	transuranic (waste)
TSCA	Toxic Substances Control Act
UIC	underground injection control
USC	U.S. Code
USDW	underground source of drinking water
UST	underground storage tank
WAC	Washington Administrative Code
WSR	Washington State Register

1.0 INTRODUCTION

1.1 PURPOSE

Waste management activities on the Hanford Site include activities to support the development and evaluation of management and disposal options for single-shell tank (SST) wastes. This report provides a review of the environmental pollution control and radioactive waste management statutes and regulations that are applicable or relevant to SST waste management and disposal activities. DOE guidance and directives are also reviewed. The applicable and relevant regulations identified in this review will be used as resources for the development of decision criteria for use in evaluating SST waste disposal options, which may include in-place disposal of the waste or retrieval of the waste from some or all of the tanks. In some instances, specific quantitative criteria for use in assessing compliance with directly applicable regulations, such as those under the Resource Conservation and Recovery Act (RCRA), are not available in those regulations. In such cases, standards from other regulations that may be used as substitute criteria for evaluating compliance with directly applicable regulations are identified. This approach is being used for SST waste because it represents a unique combination of radioactive and chemical waste. This approach may or may not be applied to other Hanford waste.

The regulatory framework surrounding radioactive mixed waste disposal must be considered in establishing decision criteria for SST waste disposal options, since the ability of an in-place disposal system to meet the requirements of applicable regulations will be an important determinant of whether waste retrieval is necessary. These regulations include specific performance, design, and permit requirements as well as constraints on the disposal of various classes of waste. Since characterization of the SST wastes will provide information to assess compliance with both types of requirements, the regulations that impact waste characterization needs must be considered in the design of waste characterization programs.

This review identifies the performance, design, and permit requirements and criteria that should be considered in 1) evaluating SST waste management

options and 2) designing an efficient waste characterization scheme that provides the information necessary to make this evaluation. These requirements are considered relevant to SST management because they may be determined to be applicable or useful in formulating criteria for disposal decisions. This report represents an initial effort to identify all regulations pertinent to SST waste management decisions. As these regulations evolve, and more information on the SST waste becomes available, the approach presented in this report will be modified.

1.2 SCOPE

Waste management decisions regarding the SST wastes must be made by taking into consideration the regulations that may impose constraints on technical solutions and those that might be used as guidelines for developing management and disposal programs that protect human health and the environment. Current waste management regulations do not specifically address radioactive mixed wastes. In the absence of such specific guidance, the SST wastes may come under the purview of a number of statutes and regulations related to radioactive waste management, hazardous waste management, and water and air quality protection. This report provides a comprehensive review of the environmental pollution control and radioactive waste management statutes and regulations that are relevant to SST waste characterization and management, as well as those that contain relevant technical standards that may be used in the absence of directly applicable regulations. Some of these statutes and regulations may later be determined to be applicable to SST waste disposal, while others will be useful in disposal decision-making. This report provides a framework that can be used to integrate the hazardous and radioactive waste management requirements, and the applicable and relevant requirements, into a form that is useful for both decision-makers and design engineers.

The U.S. Department of Energy (DOE) and the Westinghouse Hanford Company (Westinghouse Hanford) are currently managing the SSTs as active hazardous waste storage facilities; therefore, the SSTs are subject to regulation under RCRA. A RCRA Part A operating permit application for the SSTs has been submitted to the Washington Department of Ecology (Ecology). The radioactive

constituents of radioactive mixed waste are subject to regulation under the Atomic Energy Act of 1954 (AEA). Therefore, RCRA, the Washington Hazardous Waste Management Act, AEA, and their implementing regulations, which contain requirements directly applicable to SST waste management decisions, have been assessed in this report.

Statutes other than the RCRA, the Hazardous Waste Management Act, and the AEA containing relevant guidance and technical standards that may impact the choice of an SST waste management strategy have also been analyzed, along with their implementing regulations. These statutes include additional hazardous substance cleanup statutes such as the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as well as federal and state water and air quality statutes. DOE Orders that address environmental pollution control, radioactive waste management, and radiation protection have also been reviewed. Such a comprehensive assessment ensures that current, as well as evolving, regulations and policies that are directly or indirectly relevant to SST management are factored into waste characterization and management decision-making for the SSTs. [Although the information gathered during waste characterization will be used in the development of management and disposal alternatives as part of the National Environmental Policy Act (NEPA) process, the NEPA process itself is not addressed in this report.]

Many regulatory areas are currently evolving and must be monitored during the development of an SST waste management plan. For example, some state water protection programs that may be important to waste disposal decisions have not yet been developed. The integration of such changes with the current RCRA provisions may be of future significance. Hazardous and radioactive substance transportation regulations and occupational safety and health (OSHA) regulations that may become important should retrieval of the SST wastes be necessary have not been reviewed in this report; rather, the focus has been placed upon identifying the performance, design, and permit requirements that DOE should consider in determining whether in-place disposal can meet regulatory requirements or whether some or all of the wastes must be retrieved from the tanks. Also, this document focuses on the management of the tank contents

only; management of the tanks, the contaminated soils, and cribs will be addressed elsewhere.

The directly applicable legislation assessed for this report is as follows:

- RCRA, the Washington Hazardous Waste Management Act, the Washington Solid Waste Management Act, and their implementing regulations
- The Clean Air Act (CAA), the Washington Clean Air Act, the Washington Statute on Nuclear Energy and Radiation, and their implementing regulations
- The AEA and applicable implementing regulations

Other legislation and their implementing regulations that are relevant to the SST management are listed below:

- CERCLA, the Superfund Amendments and Reauthorization Act (SARA), the Emergency Planning and Community Right-to-Know Act (EPCRA)
- The Safe Drinking Water Act (SDWA)
- The Federal Water Pollution Control Act (FWPCA) as amended by the Clean Water Act (CWA), hereafter referred to as the CWA; the Washington Water Pollution Control Act
- The Nuclear Waste Policy Act (NWPA), the Low-Level Radioactive Waste Policy Act (LLRWPA)
- The Washington Water Well Construction Act
- The Washington Pollution Disclosure Act
- The Washington Regulation of Public Groundwaters statute

In addition to the above legislation, the following DOE Orders relevant to waste management, environmental pollution control, and radiation protection have been reviewed:

- DOE Order 5820.2A, "Radioactive Waste Management" (September 26, 1988)
- DOE Order 5480.1A, Chg. 6, "Environmental Protection, Safety, and Health Protection Program for DOE Operations" (August 13, 1981)
- DOE Order 5480.1B, "Environmental Protection, Safety, and Health Protection Program for DOE Operations" (September 23, 1986)

- DOE Order 5481.1B Chg. 1, "Safety Analysis and Review System" (May 19, 1987)
- DOE Order 5480.11, "Radiation Protection for Occupational Workers" (December 21, 1988)
- DOE Order 5480.11A, Requirements for Radiation Protection, September 17, 1986
- DOE Order 5490.1A, Chapter XI, Requirements for Radiation Protection, August 13, 1981, as updated by DOE Order 5480.1, Change 6, August 13, 1981
- DOE Order 5480.1A, Chapter XII, Prevention, Control and Abatement of Environmental Pollution, August 13, 1980
- DOE Order 5480.4, Environmental Protection, Safety and Health Protection Standards, May 15, 1984 - as updated by DOE 5480.4, Change 1, May 16, 1988

1.3 TECHNICAL APPROACH

The statutes and regulations identified in Section 1.2 of this report were reviewed for requirements and criteria that are important in evaluating SST waste management options and in assessing the degree of waste characterization necessary to determine whether in-place disposal of the waste can meet applicable regulatory requirements. This review identified three general types of requirements that must be met. These performance, design, and permit requirements and criteria are discussed in this report. Where specific quantitative requirements and criteria are not available in the regulations, other standards (the drinking water standards, for example) can be used to assess compliance with general qualitative requirements, such as those contained in RCRA. Performance assessments based on these standards will then be used to determine whether in-place disposal of the SST wastes is possible or whether wastes must be retrieved from some or all of the tanks.

To conduct the regulatory analysis documented in this report, background documents relevant to the SST waste management program were reviewed, and the statutes and regulations relevant or potentially relevant to SST waste management decisions were identified. These statutes and regulations, which address environmental pollution control and radiation protection, contain

requirements and criteria for protecting human health and the environment. The radiation protection statutes often contain concise, quantitative criteria for limiting radiation doses to individuals. However, in some instances, the hazardous waste statutes and regulations (such as RCRA) contain only general qualitative requirements for environmental protection. Since specific quantitative criteria for assessing compliance with the RCRA requirements are not always available in the hazardous waste regulations, other environmental pollution control statutes and regulations that prescribe numerical criteria were analyzed to determine whether they could be used as substitute criteria for evaluating compliance with RCRA.

Because the material in this report will be used in planning for waste characterization and in waste management decision-making for the SSTs, the material is presented in terms of permit, design, and performance requirements and criteria. Performance requirements are those requirements that must be met by the final waste disposal system. These requirements range from very quantitative (such as radiation dose limits for the general public) to very qualitative (such as requirements to protect the environment). Performance standards to which the final disposal system might be held accountable, and others that may be useful to decision makers, are included in this report. While performance and design requirements and criteria are specified in the regulations, they may also be specified in the conditions of a permit. Permit requirements set forth criteria that must be fulfilled to apply for, as well as to receive, a permit. For example, the requirement to submit a sampling and testing plan is a permit requirement. A permit may also specify conditions under which a facility may operate; these conditions may include performance and design requirements and criteria. The performance, design, and permit criteria approach provides a framework that integrates the various requirements discussed in this report into a form that is useful for both decision-makers and disposal systems designers.

1.4 BACKGROUND

This section presents a brief description of the SSTs and their associated wastes. The discussion is derived from background information in a Government

Accounting Office (GAO) report entitled Nuclear Waste Unresolved Issues Concerning Hanford's Waste Management Practices (GAO 1986) and the Final Environmental Impact Statement for the Disposal of Hanford Defense, High-Level, Transuranic, and Tank Wastes (HDW-EIS, DOE 1987); more detailed information can be found in the reports themselves.

Radioactive wastes have been generated on the Hanford Site since 1944 in support of national defense activities. Eight nuclear reactors were built on the Hanford Site in the 1940s and 1950s; these reactors produced plutonium until the last one was shut down in 1971. The N-reactor, a dual-purpose plutonium production and steam generation reactor, began operation in 1963, and is in the process of being placed in "cold standby" status. Companion fuel fabrication plants, chemical processing plants, and waste management facilities were also constructed and operated.

Radioactive and chemical wastes from the chemical reprocessing of irradiated reactor fuel have accumulated on the Hanford Site over the past four decades. The liquid portion of the wastes was placed in 149 underground, reinforced concrete, steel SSTs until November 1980 (Klem 1988). Since 1970, underground, reinforced concrete, double-shell steel tanks have been used to store active liquids (DOE 1987).(a) A program has been under way since 1970 to stabilize the SST wastes by removing supernatant liquid to the extent practicable; as of December 1987, 95 of the tanks had been "interim stabilized" (DOE 1987). After the stabilization program is completed, the tanks will contain various combinations of sludge, salt cake, and nonpumpable liquids.(b)

(a) Single-shell tanks are carbon-steel-lined concrete tanks, ranging in capacity from 210 to 3800 m^3. Double-shell tanks have a concrete shell and two carbon-steel liners with an annulus between the liners. This double-shell tank system provides for secondary containment and leak detection (DOE 1987).

(b) Sludge refers to the solids that precipitate when acidic liquid waste is neutralized, while salt cake is a moist solid formed by evaporation of the liquid that remains after the sludge settles (DOE 1987).

The 149 SSTs are distributed among 12 tank farms located in the 200 East and 200 West areas of the Hanford Site (see Figure 1.1). The tank farms are adjacent to the facilities that generated the wastes they contain; however, over the years, wastes from different facilities have been mixed in the tanks. Also, until November 1980, liquid wastes were transferred among the tanks and tank farms during in-place treatment of the wastes to remove liquid and to reduce in-tank heat generation by removing ^{90}Sr and ^{137}Cs. As a result, the current composition and classification of the wastes in the tanks is uncertain. However, the results of previous sampling efforts indicate that the tanks contain, in addition to radioactive materials, a variety of heavy metals and organic compounds that are listed as "hazardous" under Washington's RCRA program (WAC 173-303, DOE 1987). Some of the salts may exhibit RCRA toxic and corrosive characteristics. Thus, a number of the tanks may exhibit the characteristics of a hazardous waste under RCRA or a dangerous waste (DW) or extremely hazardous waste (EHW) under the State of Washington regulations.

Over the years, a total of 29 SSTs are confirmed to have leaked liquid waste to the soil, and 31 others are suspected of having leaked (DOE 1987). Four more confirmed leakers have been identified in recent months. A total of about 492,000 gallons of waste have leaked to the soil (GAO 1986); the largest single leak was about 115,000 gallons in 1973 (GAO 1986). Monitoring and sampling have shown that most of the wastes that leaked from the tanks were absorbed by the adjacent soil. Leak detection pits (dry-wells) adjacent to the tanks are sampled daily to weekly to determine whether new leaks have developed (DOE 1987).

The HDW-EIS, which was completed in December 1987, examined the potential impacts of alternative scenarios for the disposal of Hanford defense wastes. The preferred alternative described in the HDW-EIS called for decisions on disposal of SST wastes to be deferred pending further development and evaluation, including waste characterization and review for compliance with applicable hazardous waste regulations (DOE 1987). The Record of Decision (ROD) on the disposal of Hanford defense high-level, transuranic, and tank wastes adopted the preferred alternative as presented in the final

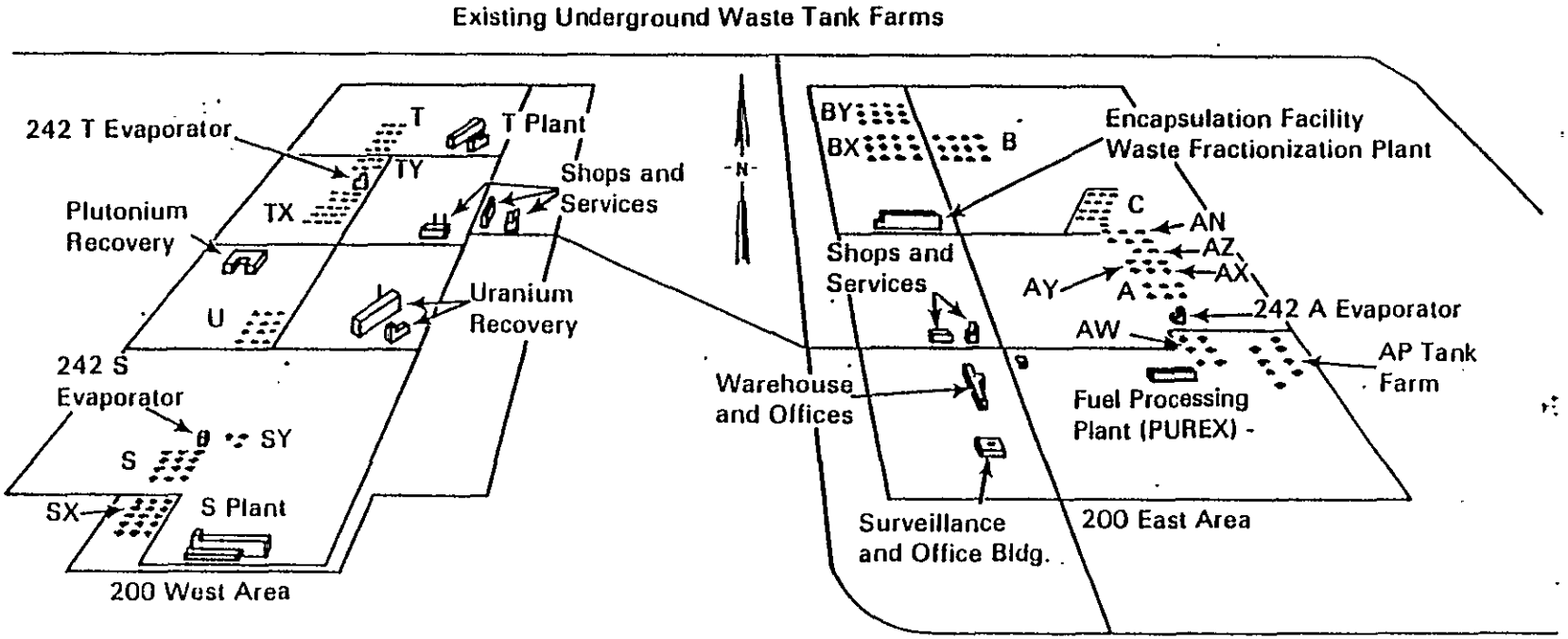

FIGURE 1.1. Schematic Representation of the Location of Single-Shell and Double-Shell Tanks Relative to Other Facilities in the 200 Areas of the Hanford Site

HDW-EIS. This report provides information important to the development of characterization plans and management strategies for these wastes.

1.5 SOURCES OF INFORMATION

A number of sources were consulted in preparing the federal and state statutory and regulatory discussions presented in Chapters 3.0 through 7.0. The primary sources of legal information were the actual statutes and regulations themselves, as they appear in the U.S. Code (USC), the Code of Federal Regulations (CFR), the Federal Register (FR), the Revised Code of Washington (RCW), the Washington Administrative Code (WAC), and the Washington State Register (WSR). Technical information was obtained from the HDW-EIS (DOE 1987), Nuclear Waste: Unresolved Issues Concerning Hanford's Waste Management Practices (GAO 1986), and the ROD for the HDW-EIS (53 FR 12449; April 14, 1988).

1.6 REPORT OUTLINE

The following chapters present information in a format that will be useful in analyzing proposed SST waste management systems. Background information is presented in Chapters 3.0 through 5.0 to provide a framework for the analysis that follows. Chapters 6.0 and 7.0 describe the performance, design, and permit requirements that may constrain technical solutions.

In Chapter 2.0, conclusions resulting from the analyses of the relevant environmental pollution control and radioactive waste management statutes and regulations conducted for this report are presented. Based on these conclusions, recommendations are made that will be important to waste management strategic planning for the SSTs. Chapter 2.0 also presents a table depicting regulatory limits associated with the SST waste constituents and a diagram illustrating the conceptual integration of radioactive and hazardous waste management (HWM) criteria.

Chapter 3.0 presents an overview of the complex regulatory regime under which waste management strategies for the SSTs must be developed.

Chapter 4.0 describes specific statutes and regulations that are relevant to SST management decisions. Some of the statutes and regulations, such as RCRA and AEA, are directly applicable to SST waste management planning; others, such as SDWA, CWA, and CERCLA, may impact the chosen waste management strategies.

Chapter 5.0 describes the waste classifications that are important to SST management decisions. Waste classifications under RCRA and AEA are complex, with the hazardous portion of radioactive mixed wastes being regulated under RCRA and the radioactive portion subject to AEA. Under the definition of hazardous waste, several categories have been developed. For example, RCRA's definition of hazardous waste has been adopted by the U.S. Environmental Protection Agency (EPA); however, Washington State refers to hazardous waste as dangerous waste. Washington State regulations then divide dangerous waste into the categories of dangerous waste and extremely hazardous waste by setting threshold toxicity levels at which dangerous wastes become classified as extremely hazardous wastes. Radioactive waste has been subdivided into high-level radioactive waste (HLW), transuranic waste (TRU), and various classes of low-level radioactive waste (LLW).

Chapter 6.0 presents a generic discussion of the permits prescribed by relevant statutes and regulations. The RCRA and CAA permits may be most directly relevant to developing waste management strategies for the SSTs; however, other permits are briefly discussed to familiarize the reader with the permitting area described in the statutes and regulations and the interrelationships among these permits. As stated previously, the regulatory agencies may impose additional performance and design criteria in the permits.

Chapter 7.0 describes the performance and design requirements found in environmental pollution control and radiation protection statutes and regulations that are relevant to SST waste characterization and management decisions. After these regulatory requirements are identified, performance criteria and standards may be developed. Performance and risk assessments will then be necessary to determine whether a proposed waste management scenario meets the criteria and to assess whether wastes can and should be disposed of in-place, given specific performance, operating, and design requirements.

The statutes and regulations include both specific requirements and general, more qualitative requirements. In some instances, specific numerical criteria by which compliance with qualitative requirements can be measured are given in the regulations. In other cases, such criteria are not available. In such cases, regulations other than those that are directly applicable may contain quantitative criteria that could be used to measure compliance with qualitative performance requirements. Such quantitative criteria are identified in this report.

2.0 CONCLUSIONS AND RECOMMENDATIONS

This chapter presents conclusions based on the major issues that emerged from the analysis of environmental pollution control and radiation protection statutes and regulations conducted for this report. The implications of these conclusions for SST waste characterization and disposal are also discussed, and recommendations that address these implications are made.

2.1 CONCLUSIONS

Many key issues important to SST waste management decisions have not yet been resolved. These issues involve waste definitions and classifications, radioactive mixed waste management, and groundwater protection requirements.

Many of the current federal and state statutes and regulations specify general requirements without providing sufficient numerical criteria for use in conducting performance assessments. Specifically, RCRA, under which the SSTs will be managed, does not prescribe sufficient numerical criteria with which to compare the results of performance assessments to determine whether in-place disposal of SST waste can meet all relevant regulatory requirements.

Numerical criteria from regulations other than RCRA can be used to demonstrate that the RCRA groundwater protection requirements have been adequately considered. RCRA contains an abbreviated list of numerical groundwater concentration limits for several hazardous constituents; however, a large number of the constituents thought to be present in the SSTs are not included on the list.

While regulations specific to radioactive mixed waste disposal have not been promulgated, the 25 mrem limit on annual dose to any member of the public (all pathways) resulting from radioactive waste disposal activities and other operations is repeated in several regulations and may be applied to an in-place disposal system for the SST wastes. However, the apportionment of dose limits among the various waste management activities on the Hanford Site will result in the application of a portion of the 25 mrem annual limit to the SSTs.

The most significant design requirements identified in this report are the RCRA requirements for closure and postclosure care of a tank system, which include requirements for removing or decontaminating all waste residues, contaminated system components, contaminated soils, and equipment contaminated with waste. If all the contaminated soils can not be practicably removed or decontaminated, a tank system may be closed in accordance with the landfill requirements. The possibility of closing the SSTs as RCRA landfills will depend, in part, on the feasibility of meeting the landfill performance and design standards for closure/postclosure care (or obtaining the appropriate variances).

Variances from the RCRA tank system regulations for tank integrity, secondary containment, response to leaks or spills, and some closure and postclosure requirements may need to be obtained for in-place disposal. For example, secondary containment must consist of either a liner external to the tank or a vault designed and operated to contain 100 percent of the capacity of the largest tank within the boundary, or a double-shell tank or other approved device. The secondary containment system must be capable of preventing migration of wastes from the system. In addition, all contaminated soils that cannot be practicably removed or decontaminated may be left in place in accordance with the closure requirements. However, the closure requirements do not provide for wastes remaining in the tank or for tank systems that are not decontaminated to be left in place.

Even though the exact contents and concentrations of wastes in the SSTs are uncertain, example calculations that average suspected constituent inventories over the entire SST waste volume can be used to identify the constituents that will be of particular regulatory concern. Such an example calculation indicates that the chromium concentration in at least some tanks probably exceeds the regulatory limits under RCRA and relevant standards under CERCLA and the SDWA (see Table 2.1). (That is, if the chromium inventory, distributed uniformly in all SST waste, causes the regulatory limits to be exceeded, then the actual concentrations will probably indicate that some tanks may exceed the limits while others may not.) If the results of an extraction procedure (EP) toxicity test indicate that the RCRA regulatory limit for chromium has

TABLE 2.1. Example Application of Regulatory Limits to Identify Key SST Waste Constituents[a]

		RCRA					SDWA	
		Washington State			Federal			
Level Constituent	Concentration Averaged Over All SST Waste (mg/L)	Groundwater (mg/L)	Extremely[b] Hazardous Waste (mg/L)	Dangerous[b] Waste (mg/L)	Groundwater (mg/L)	EP Toxicity (mg/L)	Maximum Contaminant (mg/L) Federal	State
Cd	30	0.01	>100	1-100	0.01	1.0	0.01	0.01
Cr	700	0.05	>500	5-500	0.05	5.0	0.05	0.05
Hg	6	0.002	>200	.2-20	0.002	0.2	0.002	0.002
F	6×10^3	----------listed[c]----------			-------listed[c]-------		4.0	2.0
NO_3	7×10^5	---[d]	---	---	---	---	10[e]	10[e]

(a) Excerpted from Tables A.1 and A.2 of this document, which provide information on the wastes thought to be present in the SSTs and the extent to which regulatory limits for these constituents exist. Estimates of the average concentrations were obtained by assuming that the constituent quantities given in DOE (1987) are uniformly distributed in the SST waste. (Total SST waste quantities were also obtained from DOE 1987.) These estimates are not intended to quantify the actual waste concentrations in the individual SSTs, but merely to indicate the relative significance of each constituent to aid in the development of a waste characterization program.

(b) These columns have been extracted from the EP toxicity test list at WAC 173-303.

(c) The constituent is regulated, but no specific limits are given.

(d) No limit found in the regulations.

(e) As NO_3.

been exceeded, then the contents of a tank may be classified as EHW, which is subject to the land disposal restrictions described in Section 7.1 of this report. (The regulatory limits under CERCLA and the SDWA refer to groundwater and drinking water standards; if a contaminant is already present in the groundwater, then high concentrations of that constituent in the SSTs may be of heightened regulatory concern.) Thus, chromium may be a key constituent around which to develop waste characterization plans that will provide the information needed to determine whether retrieval of the wastes is necessary based on the hazardous waste content. Additional key constituents (both hazardous and radioactive) may be identified by this type of calculation or

by other methods.[a] Other waste constituents may be found in the tanks in quantities of concern to the regulators; these appear on the lists of RCRA-regulated constituents, but specific concentration limits are not provided for such "RCRA-listed" wastes (although they are provided for RCRA wastes designated as hazardous on the basis of specific characteristics). These constituents include nitrogen oxides (nitrates and nitrites), nickel, and fluorine.

Groundwater protection will be one of the most important factors in determining whether in-place disposal of the SST wastes will be acceptable to the regulatory agencies. Groundwater protection is covered in a variety of statutes, and the EPA has had at least two sets of environmental protection standards for radioactive wastes vacated and portions remanded for review and revision by EPA because their groundwater protection provisions were found lacking.[b] Because of this regulatory concern, performance assessments for in-place disposal systems must attempt to determine the degree of protection afforded the groundwater by the proposed system design.

Current waste management regulations do not specifically address radioactive mixed wastes. In the absence of such specific guidance, the SST wastes may come under the purview of a number of statutes and regulations related to radioactive waste management, hazardous waste management, and water and air quality protection. The SST wastes are subject to a joint RCRA/AEA regulatory regime, so assessing compliance will be a complex issue. Inconsistencies that arise in the application of requirements under both statutes may be addressed by obtaining, in some cases, waivers from RCRA requirements, as provided for in the RCRA regulations.

(a) Additional calculations may involve performance and risk assessments, statistical analyses, preliminary waste analysis, and other forms of analysis.

(b) The vacated ground water protection provisions are found in 40 CFR 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Waste," and 40 CFR 192, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings."

The evolution of waste classifications and definitions may have significant implications for waste characterization needs and retrieval requirements. Figure 2.1 depicts the waste classifications defined in the various statutes and regulations that could be important to the development of a characterization and disposal plan for the SST wastes. Each waste class defined by chemical and radioactive constituent content is subject to specific regulations. The various areas indicate the type of disposal for each waste class under the current regulatory framework. If on-site land disposal of certain waste classes, such as EHW or HLW, were prohibited, then simplified waste characterization plans could be designed to simply confirm the presence or absence of either waste (see Chapter 5.0). It should also be noted that additional regulatory restrictions, such as bans on the land disposal of liquids, could also influence the need for retrieval. Further discussion of waste classifications is presented in Chapter 5.0.

2.2 RECOMMENDATIONS

Applicable regulatory requirements under RCRA, CAA, and AEA will be important and should be addressed throughout the SST waste management and disposal program. Other relevant regulations and guidance should reviewed for their usefulness to the SST program. Figure 2.2 illustrates the relationships between the regulatory requirements and other program elements, which include waste characterization, performance assessment, technology needs assessment, and evaluation and comparison of disposal options. These relationships are discussed below.

Applicable and relevant regulatory requirements, standards, and guidance will be important to waste characterization efforts [labeled (a) in Figure 2.2] in several ways. First, the statutes and regulations discussed in this report define a number of chemical and radioactive waste classes, each of which is subject to specific regulatory requirements. In addition, the disposal of some waste classes may be prohibited or very strictly regulated. Thus, waste characterization programs must provide the information needed to classify the SST wastes, and waste sampling and analysis plans must be developed to obtain this information. The regulatory requirements under RCRA include extensive

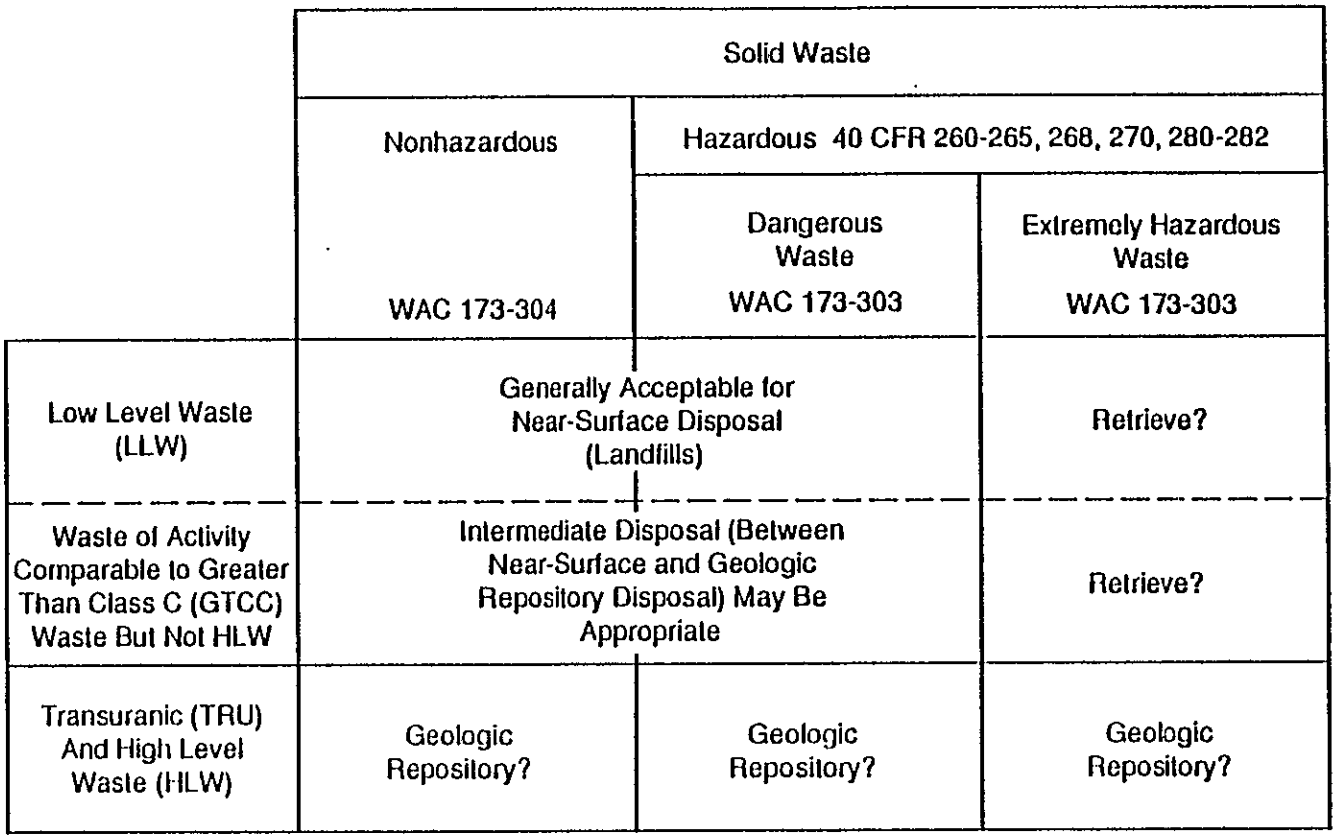

FIGURE 2.1. Conceptual Integration of Radioactive and Hazardous Waste Management Criteria

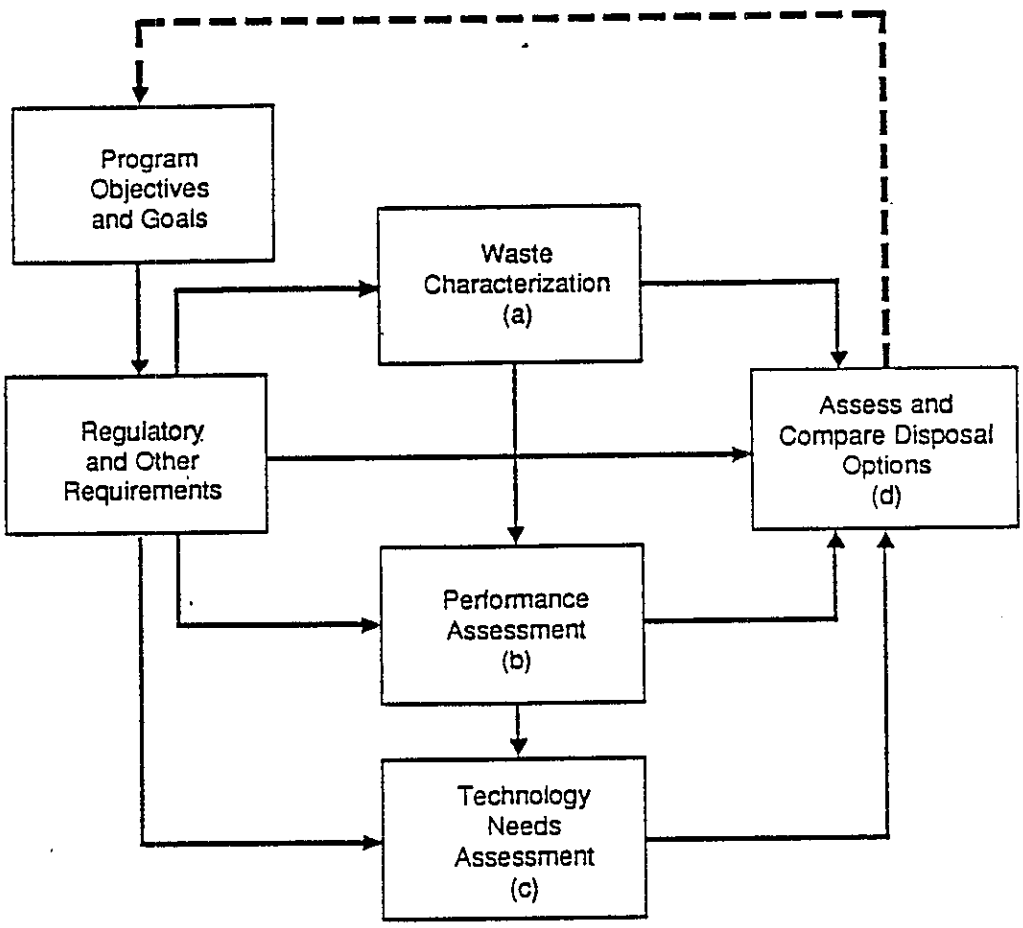

FIGURE 2.2. Relationships Between Regulatory Requirements and SST Waste Disposal Program Elements

characterization requirements that may be imposed on the SST waste disposal program; however, the interface with AEA may, in some cases, allow some sampling requirements to be waived if occupational exposures (which are not discussed in detail in this report) during the sampling would be unreasonably high.

Regulations also set performance criteria (such as dose limits for members of the public) that an in-place disposal system may be required to meet. Waste characterization must provide the information needed to conduct performance assessments [labeled (b) in Figure 2.2] against such criteria. Regulatory requirements will also be important to performance assessment in specifying allowable configurations of in-place disposal systems. Requirements for both engineered barriers and the performance of the surrounding geohydrology may be specified.

Regulations that impact the disposition of the wastes will also impact the assessment of technology needs [labeled (c) in Figure 2.2] and the ultimate development of technologies. For example, requirements to sample, retrieve, or process waste; to provide engineered barriers or leak detection systems; to meet performance criteria; or to maintain radiation exposures as low as reasonably achievable (ALARA) may all be "technology-forcing" in that they require the development of new technologies or processes. The feasibility of meeting some of these requirements may be a factor in the evaluation and comparison of disposal options.

Regulations will also directly impact the evaluation of disposal options [labeled (d) in Figure 2.2], particularly if certain waste classes cannot be disposed of on the land or would be subject to NRC licensing. In addition, NEPA compliance (which is not addressed in this report) will be important to the final evaluation and comparison of alternatives for SST waste disposal.

In summary, regulations will be important to a number of SST waste disposal program elements, often serving as the mechanism for interfacing among the elements. These interactions should be understood and fostered as the SST program develops.

In areas that RCRA regulations do not provide specific performance criteria, "substitute" numerical criteria should be used to compare with the results of performance assessments for in-place disposal systems. One method is to use criteria from relevant regulations that specify numerical criteria in these areas. One of the most important areas falling into this category is groundwater protection. The list of RCRA Interim Primary Drinking Water Standards at 40 CFR 265, Appendix III, should be supplemented with the SDWA's maximum contaminant levels (MCLs) and the CERCLA reportable quantities (RQs). The MCLs should be considered as substitute groundwater protection performance criteria for showing that the intent of the RCRA requirements has been met. The RQs should be used, not as specific numerical performance criteria, but as indicators of the hazardous constituents that are of most concern to the regulators. If the RCRA standards and the MCLs cannot be met for some or all of the waste constituents, then alternate concentration limits (ACLs) under RCRA, which are negotiated with the regulatory agencies, should be used.

In the area of radiation protection, performance criteria similar to those in 40 CFR 191 (which are similar to radiation protection requirements repeated in several regulations) will probably be applied to any in-place disposal system for the SST wastes, and should be used in conducting performance assessments. For both groundwater and radiation protection, the revisions of 40 CFR 191 should be tracked. Although the 25 mrem/year annual population dose standard will probably not change, the court has required EPA to either revise the groundwater protection standards to conform with requirements under the SDWA, or explain and justify the discrepancy, to address the issues raised in the 1987 court decision [Natural Resources Defense Council vs. EPA, No. 85-1915, 86-1096 to 86-1098 (First Circuit; July 17, 1987)]. The potential apportionment of radiation dose limits among waste disposal activities on the Hanford Site should be considered in conducting the performance assessments.

The decision-making process for SST waste disposal is still in its early stages. Thus, a third recommendation emerging from this analysis is that **tracking of the evolving regulatory regime surrounding radioactive mixed waste be made an integral part of waste disposal planning. A "feedback loop" should be established through which changes in regulatory requirements, definitions, and interpretations can be assessed early enough in the planning process to ensure that decisions are made based on the most current regulatory requirements and on a knowledge of the areas in which significant changes are likely.** This will aid decision-makers in building the flexibility into the decision-making process necessary to accommodate regulatory changes without significantly impacting the SST waste disposal program.

Specific areas in which regulatory tracking is needed include the following:

- Evolving definitions of HLW and EHW
- Regulatory interpretations, including agency policies, and court cases such as the one that vacated the EPA's environmental standards for waste disposal in 40 CFR 191. Also, regulatory interpretations regarding NRC licensing authority over in-place disposal systems
- Promulgation of RCRA corrective action and cleanup provisions

- Regulatory action on any of the regulations addressing groundwater should be considered for their usefulness to the SST program.

The yet-to-be promulgated RCRA corrective action regulations could have significant impacts on the standards that an in-place disposal system must meet. In addition, since the EPA may modify the RCRA regulations so that they more closely resemble regulations under CERCLA, consideration should be given to following all but the administrative procedures for CERCLA cleanup actions in designing a waste disposal system (Friedman 1987).

A final recommendation is that, as the SST wastes are further characterized, the information provided in this report should be developed further for specific applicability to the SSTs, and the detailed requirements impacting various waste constituents found to be present should be integrated into the waste management decision-making process.

3.0 OVERVIEW OF THE REGULATORY PROCESS

This chapter presents a broad overview of the complex regulatory regime under which waste management strategies for the SSTs must be developed. The discussion describes the environmental pollution control and radiation protection regulations from which performance, design, and permit criteria for waste management systems are derived. These criteria may be prescribed in the regulations or in a permit, as discussed below. (Criteria may also be prescribed in court cases in which the relevant statutes and regulations were interpreted; these sources of criteria are not discussed in this report.)

3.1 ENVIRONMENTAL POLLUTION CONTROL CRITERIA

In general, the statutes and regulations discussed in this report protect human health and the environment by regulating discharges to the air, groundwater, surface water, and soil. To accomplish this, the regulations contain performance and design standards and criteria which must be met by waste management systems. Permits may also be required; these permits often prescribe the specific performance and design criteria that must be met to satisfy the regulatory standards.

As noted above, performance and design criteria are often prescribed by the conditions set forth in a permit. Many environmental protection statutes such as the CAA, CWA, SDWA, and RCRA include permit requirements. Some permits authorize discharges of substances to the environment, while others are required before waste management and other facilities are allowed to operate. The permits for a facility may be issued by several regulatory agencies, such as the EPA, Ecology, the Washington Department of Social and Health Services (DSHS), and local pollution control authorities.

Some statutes, while not containing permit provisions, do contain permit-like conditions. For example, the regulations under CERCLA describe a decision-making process in which final decisions are documented in a ROD that specifies the conditions under which the final decisions will be implemented. Some legislation also contains "permits-by-rule" that allow an activity to con-

tinue if it meets criteria specified in the regulations, without the need to obtain an actual permit.

The regulations and permits may contain variance provisions for performance, design, and permit requirements. These variances may prescribe criteria that are different from those found in the regulations if the regulatory agencies determine that human health and the environment are adequately protected or if the requirements cannot be met because of site-specific conditions.

3.2 REGULATION OF FEDERAL FACILITIES

In general, environmental regulation of federal facilities arises from federal law in two ways:

- A federal law may provide for direct regulation of one federal agency by another (for example, direct regulation of federal facilities by the EPA).
- A federal law may provide for a federal agency (usually EPA) to authorize state regulation of federal facilities or may authorize direct regulation of federal facilities by the states (waiver of sovereign immunity).

The state may in turn delegate some of its regulatory authority (by statute) to local authorities. Those federal statutes that provide for state regulation to some extent include RCRA, SDWA, CAA, AEA, and sections of the CWA.

Figure 3.1 illustrates the regulatory process. There are several overlaps in this process; for example, the Energy Reorganization Act of 1974 (ERA) delegates authority under the AEA to the Nuclear Regulatory Commission (NRC) and the DOE.

Taken together, the AEA (42 USC 2001 et seq.) and the ERA (42 USC 5811 et seq.) establish NRC authority over commercial nuclear activities and DOE self-regulatory authority over activities within its purview. However, the NRC does have authority over some activities of the DOE, including licensing and regulatory authority over certain fuel cycle activities. Further waste characterization and evaluation will be required to determine whether the SST wastes are HLWs subject to NRC licensing (see Section 5.2.2). Government Reorganization Plan No. 3 of 1970 delineated responsibilities between EPA and NRC and gave EPA authority over part of the environmental aspects of

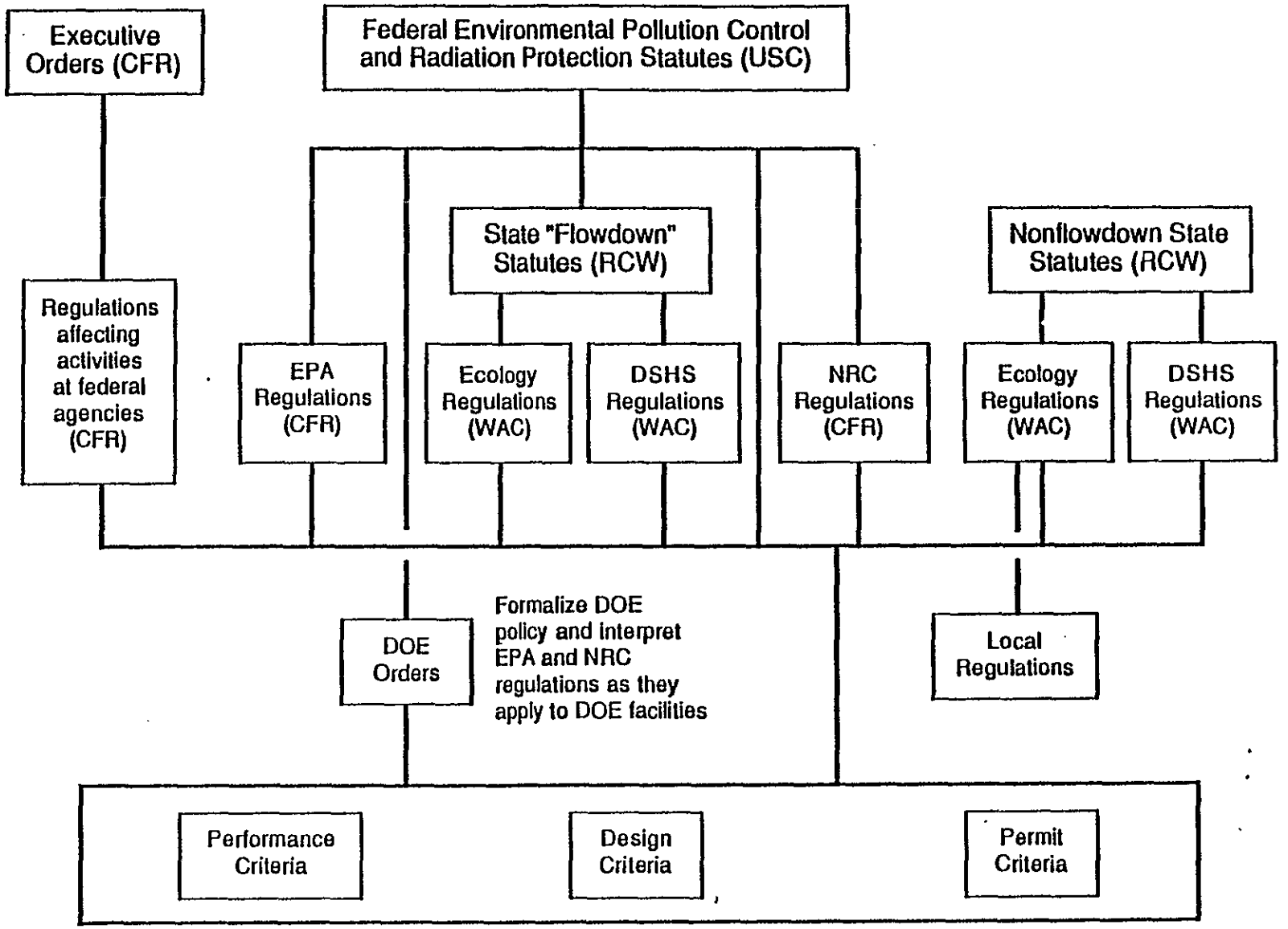

FIGURE 3.1. Roadmap to the Regulatory Process for Management and Disposal of Nuclear and Hazardous Waste

radiation protection.

Under the AEA, certain regulatory authority is granted to states that enter into agreements with the NRC (called "Agreement States"). For example, states can regulate the possession, use, and transfer of source, special nuclear, or byproduct material in quantities not sufficient to form a critical mass. This authority applies only to authority retained by the NRC under the ERA.

Congress has enacted federal environmental pollution control and radiation protection statutes (published in the USC) that direct EPA and/or NRC to promulgate implementing regulations, which are published in the CFR. These statutes may also direct or authorize the states to develop regulatory programs. The State of Washington has developed "flowdown" and "nonflowdown" statutes that are published in the RCW. The state statutes direct the Ecology and the DSHS to develop regulations. These state regulations are published in the WAC. The CFRs and WACs are updated by rules published in the FR and the WSR, respectively.

Executive Orders are written and signed by the President of the United States. They are generally used by the President to direct and govern activities of government officials and agencies. Executive Orders can stand alone, can be implemented by regulations, or can further the policy and guidance in statutes.

The DOE Orders formalize DOE policy and interpret EPA and NRC regulations as they apply to DOE facilities. They also provide guidance to DOE contractors and employees. These Orders include by reference many of the federal environmental pollution control statutes and require compliance with those statutes that are applicable to DOE activities. In some instances, DOE has developed within its Orders more stringent criteria than those found in the regulations.

Summaries of the applicable or relevant statutes and regulations are presented in Chapter 4.0 of this report.

4.0 RELEVANT STATUTES, REGULATIONS, AND ORDERS

This chapter describes the specific statutes and regulations that are applicable or that may be relevant to SST management decisions. These descriptions provide background information that will provide a framework for the discussions in the following chapters.

The SSTs contain radioactive mixed waste, which is subject to a complex and changing regulatory regime. Some of the statutes and regulations, such as RCRA and AEA, are directly applicable to SST waste management planning; others, such as the SDWA, CWA, and CERCLA, may be appropriate to consider as guidance in developing waste management strategies. For example, groundwater is protected under RCRA, SDWA, CWA, CERCLA, NWPA, and their implementing regulations. The goals of these statutes addressing groundwater protection, and the implementing regulations must be clearly understood before a comprehensive waste management strategy can be fully developed. To aid in clarifying these goals, this chapter presents an overview of the statutes and regulations discussed in this report. Each statute, its purpose, its implementing regulations, and the responsible regulatory agencies are described. Because of their potential relevance to SST waste management, some of the EPA and the NRC regulations implementing the AEA, the LLRWPA, and the NWPA are discussed under their own subsections. This chapter also discusses several DOE Orders.

4.1 STATUTES AND REGULATIONS THAT MAY BE APPLICABLE TO SST WASTE MANAGEMENT DECISIONS

This section describes the statutes and regulations that are currently applicable, or that may be determined to be applicable, to SST waste management and disposal.

4.1.1 Resource Conservation and Recovery Act of 1976 (RCRA)

As discussed in Section 1.2, the SSTs are active waste storage facilities and thus subject to regulation under RCRA. Because the SSTs store hazardous waste, they will be managed under Subpart J, tank systems regulations (40 CFR

265.190 through .201). In addition, any SST leaks or spills will be regulated under RCRA's corrective action program, which EPA is currently developing.

RCRA provides for "cradle-to-grave" regulation of the generation, transportation, storage, treatment, and disposal of hazardous and non-hazardous solid waste. The primary objectives of RCRA are to promote the protection of human health and the environment and to conserve material and energy resources. RCRA was amended in 1984 by the Hazardous and Solid Waste Act and can be found at 42 USC 6901-6991. The regulations to implement the Act are available at 40 CFR 124 and 240 through 282. The regulations of interest in developing the waste characterization plan and making waste management decisions are set forth at 40 CFR 260-265 (solid waste management), 271 (permit programs), and 280-282 [underground storage tanks (USTs)]. Washington's Hazardous Waste Management Act and its implementing regulations (RCW 70.105 and WAC 173-303) provide the framework for the EPA-authorized state program implementing RCRA.

RCRA, as amended, contains nine subtitles. Subtitle C, "Hazardous Waste Management," Subtitle D, "State and Regional Solid Waste Plans," and Subtitle I, "Regulation of Underground Storage Tanks," constitute the substantive portion of the law. All three subtitles may influence waste management decisions because the tanks may contain hazardous and non-hazardous solid waste. The remaining subtitles provide the legal and administrative structure for achieving the objectives of the law.

As stated previously, the SSTs are regulated under Subtitle C (Subpart J of 40 CFR 265) of RCRA, and EPA has developed tank system regulations for tanks that are used for storage or treatment of hazardous waste. These regulations include requirements for the design, operation, closure, and postclosure care of tanks. Under these federal regulations, tank systems cannot be closed as landfills. The Washington dangerous waste regulations do not currently contain such a provision; however, they are being revised to allow closure of contaminated soils as a landfill. The regulations as currently written are presented in this document.

EPA has proposed new rules for the regulation of USTs under Subtitle I of RCRA. In the background information accompanying the proposed rules, the

DOE's defense waste tanks at Hanford, Savannah River, and Idaho Falls are discussed. It is noted that, because of the unique nature of the materials stored in the tanks (radioactive materials/CERCLA-defined hazardous substances), EPA has considered developing a separate set of standards that apply to defense waste tanks only. EPA states that, "This may be unnecessary for tanks containing high-level radioactive waste (HLW) in view of the fact that the DOE already has in place a program that adequately addresses, and sometimes exceeds, the proposed requirements for the average UST system" (52 FR 12688; April 17, 1987). To the extent that the SSTs may contain HLW, any new EPA Subtitle I standards could be relevant to waste management decisions. The regulations as they currently stand are discussed in this document, as well as DOE's program as set forth in the DOE Orders.

RCRA contains corrective action provisions that are similar to CERCLA's cleanup provisions. The goals of both statutes should be understood because EPA may modify the RCRA regulations so that they more closely resemble the CERCLA regulations for cleanup (Friedman 1987). Consideration of these goals should be an integral part of waste management strategy.

The Washington Hazardous Waste Management Act (RCW 70.105) is similar to that of RCRA Subtitle C and provides a regulatory framework for implementation of RCRA (WAC 173-303). Specific regulations for managing tanks that store hazardous waste are found at WAC 173-303-640. The purpose of the Washington Solid Waste Management Act (RCW 70.95) is to establish a state-wide program for handling, recovering and recycling nonhazardous waste in a manner that will prevent land, air, and water pollution. The implementing regulations are available at WAC 173-304.

Effective January 1986, EPA authorized Ecology to implement the 1976 version of RCRA. On September 22, 1987, Washington State requested final authorization for certain state program revisions developed in response to some of the 1984 Amendments to RCRA. These revisions incorporate the federal redefinition of solid waste, revisions to interim status standards for hazardous waste landfills, hazardous waste listings, and the regulation of radioactive mixed wastes. Washington's program became effective on November 22, 1987 (52 FR 35556; February 22, 1987). EPA is the regulatory agency for the remain-

der of the 1984 amendments, including the corrective action requirements, until Washington receives approval for the rest of the 1984 Amendments.

4.1.2 Atomic Energy Act of 1954 (AEA)

The AEA (42 U.S.C. 20111 et seq.) establishes the authority of the U.S. Government [via the Atomic Energy Commission (later the NRC) and the DOE] to regulate the production and use of source, byproduct, and special nuclear material in the interest of the common defense and security and to protect the health and safety of the public.

4.1.3 Energy Reorganization Act of 1974 (ERA)

As described in the previous chapter, the ERA (42 U.S.C. 5811 et seq.) establishes NRC regulatory authority over commercial nuclear activities and DOE self-regulatory authority over its activities. However, under Section 202 of the ERA, the NRC has authority over some activities of the DOE, including licensing and related regulatory authority over certain fuel cycle activities. Among other provisions, the Section requires NRC licensing of those DOE facilities authorized for the express purpose of long-term storage of HLW that is not used for, or is not a part of, research and development activities.

4.1.4 40 CFR 191, Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes

These regulations, promulgated by EPA under the AEA and the NWPA, contain environmental radiation protection standards for management and disposal of spent nuclear fuel, HLW, and TRU wastes. Subpart A of 40 CFR 191 sets forth radiation protection standards applicable to radiation doses received by members of the public as a result of the management and storage of the above wastes at facilities regulated by the NRC (or Agreement States) and at high level and TRU waste management and storage facilities operated by the DOE and not regulated by the NRC or Agreement States. Subpart B sets forth requirements applicable to the release of radioactive materials into the accessible environment as a result of the disposal of wastes, to radiation doses received by members of the public as a result of such disposal, and to radioactive contamination of certain sources of groundwater in the vicinity of such disposal

systems. Thus, if the SSTs contain HLW or TRU waste, and the waste is disposed of in place, the disposal may be subject to regulation under 40 CFR 191.

The U.S. First Circuit Court of Appeals (Natural Resources Defense Council et al. vs. EPA, Civil Action 85-1915, July 17, 1987) vacated and remanded Subpart B of 40 CFR 191 to EPA for further consideration. The court found that the standards for disposal of HLW conflicted with the requirements of the SDWA that underground sources of drinking water not be endangered. The court found it acceptable that the HLW standards permit noncompliance with the SDWA within the controlled area for most categories of groundwater (except special sources of groundwater). However, the vacated individual protection requirements would have allowed underground drinking water sources outside the controlled area to be degraded to levels beneath the standards EPA had established under the SDWA.

4.1.5 40 CFR 193, Environmental Standards for the Management, Storage, and Disposal of Low-Level Radioactive Waste

These regulations will be promulgated by the EPA under the AEA and the LLRWPA. When issued, the regulations will set environmental radiation protection standards for land disposal of LLW at NRC-(or Agreement State-) licensed or DOE-authorized disposal sites. Thus, if the SSTs contain LLW and if the waste is disposed of in place, the disposal may be subject to regulation under 40 CFR 193. A draft version was released to federal agencies for comment in 1987.

Subpart A of the version of 40 CFR 193 prepared for agency comment sets forth radiation protection standards for the management, processing, and storage of LLW. It also defines criteria to be used in identifying those wastes that are below regulatory concern and that do not have to be disposed of in regulated LLW disposal facilities. Subpart B sets forth radiation protection standards for LLW land disposal facilities, while Subpart C establishes groundwater contamination limits for management, storage, and disposal facilities.

4.1.6 Clean Air Act (CAA)

Radioactive airborne emissions from the tank farms are subject to regulation under the federal CAA (42 USC 7401, et seq.), the Washington CAA

(RCW 78.94), General Regulation 80-7, and the Washington statute on nuclear energy and radiation (RCW 70.98). The regulations implementing these statutes are Source Terms (40 CFR 50-51); Prevention of Significant Deterioration (PSD) Program (40 CFR 52); Ambient Air Standards for Hazardous Air Pollutants, Non-compliance, and Exemptions (40 CFR 61-81); Air Pollution Sources (WAC 173-400); Air Contaminant Sources (WAC 173-403); Ambient Air Quality Standards and Emission Limits for Radionuclides (WAC 173-480); and Monitoring and Enforcement of Air Quality and Emission Limits for Radionuclides (WAC 402-80).

The basic purpose of the federal CAA is to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population" [42 USC 7401(b)(1)]. The basic purpose of the Washington CAA is "to secure and maintain such levels of air quality as will protect human health and safety and comply with the requirements of the federal CAA, and, to the greatest degree practicable, prevent injury to plant and animal life and property, foster the comfort and convenience of [the state's] inhabitants, promote the economic and social development of the state, and facilitate the enjoyment of the natural attractions of the state" (RCW 70.94.011). The basic purpose of the Washington statute on nuclear energy and radiation is to protect the public health and safety and to institute and maintain a regulatory and inspection program for sources and uses of ionizing radiation so as to provide for: 1) compatibility with the standards and regulatory programs of the federal government, 2) a single, effective system of regulation within the state, and 3) a system consistent insofar as possible with those of other states (RCW 70.98.010).

4.1.7 DOE Orders

The DOE Orders formalize DOE policy and interpret EPA and NRC regulations as they apply to DOE facilities. They also provide guidance to DOE contractors and employees on a variety of topics, including waste management, environmental protection, and radiation protection. These Orders include by reference many of the federal environmental pollution control and radiation protection statutes and require compliance with those statutes as they are applicable to DOE activities. In some instances, DOE has developed within its Orders more stringent criteria than those found in the regulations.

Relevant DOE Orders addressing waste management, environmental protection, and radiation protection are described below.

4.1.8 Waste Management and Environmental Protection

DOE Orders (5480.1A, 5480.1B, 5480.4, 5490.1A, 5481.1B, and 5820.2A) that contain guidance on waste management, environmental protection, and individual radiation protection are discussed in Chapter 7.0. While some DOE Orders are almost solely devoted to outlining specific performance, permitting, or design criteria, other Orders are broad-based, nonspecific documents that are primarily used for general guidance. Specific requirements and overall guidance objectives are discussed in Chapter 7.0.

4.1.9 Occupational Radiation Protection

Presidential guidance to federal agencies for the protection of workers exposed to ionizing radiation was updated in January 1987 (52 FR 2822). New recommendations from the International Commission on Radiological Protection (ICRP) on radiation protection philosophy and limits for occupational exposure are included in the guidance. The radiation protection guidance is based on the assumption that the risks of injury from exposure to radiation should be considered in relation to the overall benefit derived from the activities causing the exposure. The DOE implements the federal guidance for DOE facilities via DOE Order 5480.11, Radiation Protection for Occupational Workers. At Hanford, this Order is supplemented by DOE-RL Order 5480.11A, Requirements for Radiation Protection).

4.2 STATUTES AND REGULATIONS RELEVANT TO SST WASTE MANAGEMENT DECISIONS

This section describes the statutes and regulations that are not directly applicable yet may be useful in SST waste management decisionmaking.

4.2.1 Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)

As previously stated, EPA may make its RCRA corrective action provisions more similar to the CERCLA cleanup provisions. For example, a CERCLA-type remedial feasibility investigation (RFI) may be required under RCRA. By

understanding the CERCLA process and how it may be incorporated into the RCRA process, changes in regulatory requirements and policies that may be important to SSTs may be anticipated. Waste disposal decisions that are based on such a comprehensive understanding of the evolving regulatory regime for HWM can then be structured to incorporate future regulatory changes without causing major delays in the SST waste disposal program.

CERCLA provides for liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and for the cleanup of inactive hazardous waste disposal sites. This Act was amended in 1986 by SARA and is codified at 42 USC 9601-9657. The implementing regulations are found at 40 CFR 300 [National Oil and Hazardous Substances Pollution Contingency Plan (NCP)] and 40 CFR 302 (Designation, Reportable Quantities, and Notification). EPA proposed revisions to the NCP on December 21, 1988 (53 FR 51394) to incorporate changes mandated by SARA.

The EPA is the responsible regulatory and enforcement agency for CERCLA rather than Ecology because this statute does not give the State of Washington regulatory authority. Under the authority of CERCLA, EPA promulgated regulations designating as hazardous substances those elements, compounds, mixtures, solutions, and substances that, when released into the environment, may present substantial danger to the public health or welfare or the environment. The EPA has also promulgated a list of RQs for hazardous substances (40 CFR 302), and has revised the NCP for the removal of oil and hazardous substances to establish procedures and standards for responding to releases of hazardous substances, pollutants, and contaminants (40 CFR 300).

4.2.2 Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 (SARA Title III)

A discussion of EPCRA is included in this report because the extremely hazardous substance RQs designated under the Act could be used as a basis for assessing the relative importance that the regulatory agencies attach to individual hazardous constituents. This information can be used as input to the development of criteria for use in performance assessments.

Title III of SARA is a free-standing law [known as EPCRA (42 USC 1101-11050)], which is implemented by the regulations at 40 CFR 355 (Emergency Planning and Notification). Under EPCRA, state commissions, planning districts, and local committees will be informed of the types and quantities of EPCRA-defined extremely hazardous substances that are maintained at facilities within their communities. Releases of such substances in amounts equal to or greater than their RQs from facilities must be reported to the National Response Center, as well as to state and local emergency planning commissions. EPCRA also requires that releases of CERCLA-defined hazardous substances in amounts equal to or greater than their RQs be reported to state and local emergency response commissions. EPA, which is the responsible regulatory body, published a list of extremely hazardous substances at 40 CFR 355. This list contains an RQ in the event of a release and a threshold planning quantity (TPQ) for each substance listed. The TPQs are regulatory limits for the amounts of extremely hazardous substances a facility can maintain at one time.

4.2.3 Washington's Hazardous Waste Cleanup Act

The Washington Hazardous Waste Cleanup Act is Washington's version of CERCLA. It is discussed here because the policy and regulations of this Act, which are yet to be developed, may be important to waste SST management strategies, even though they are not applicable to facilities that are placed on CERCLA's National Priorities List (NPL). On July 14, 1988, the Hanford Site, which includes the SSTs, was proposed for listing on the NPL (53 FR 23988).

This Act became effective on October 16, 1987 (Senate bill no. 6085) and directs Ecology to promulgate implementing regulations. In the November 1988 elections, an initiative was passed that requires the Washington State legislature to reexamine this Act. During the next year, decisions to amend or repeal this Act will be made. Until statutory changes are enacted, this law remains the legislative authority for hazardous waste cleanup programs.

The purpose of the Act (RCW 70.105B) is to maintain a healthful environment by providing for the cleanup of hazardous waste sites in the State of Washington. Ecology will determine which releases are subject to state reporting and notification requirements. Releases that are of a magnitude that

would cause a significant adverse impact to human health or the environment will be subject to these regulations.

4.2.4 Nuclear Waste Policy Act of 1982 (NWPA)

While the NWPA is not directly applicable to SST waste management decisions, some of the implementing regulations may be useful in evaluating SST disposal options. The NWPA (42 USC 10101 et seq.) creates a federal program to develop a waste disposal system for HLW and spent nuclear fuel, and is primarily concerned with disposal in geologic repositories. The relevant NRC implementing regulations for these wastes are available at 10 CFR 60, "Disposal of High-Level Radioactive Wastes in Geologic Repositories."(a) The NWPA will be applicable to the disposal of any DOE wastes that are disposed of in an NRC-licensed geologic repository. The NWPA does not require that all materials regarded as HLW be disposed of in a geologic repository; however, Section 8(a)(3) of the NWPA requires that any repository for the disposal of HLW resulting from atomic energy defense activities only shall be subject to licensing by the NRC under the ERA (42 USC 5842).

The regulatory domain for HLW disposal is not yet fully developed. In the background discussion accompanying its advance notice of proposed rulemaking (ANPR) on the definition of HLW, the NRC notes that, while the NWPA does not require that all HLW be disposed of in a mined geologic repository, the NWPA does not specifically authorize DOE to construct or operate facilities for disposal by alternate means (although it does direct DOE to conduct research on alternate technologies for the permanent disposal of HLW). Therefore, new legislative authorization might be needed to dispose of HLW in such facilities (52 FR 5993; February 27, 1987). In addition, if NRC licensing is required, additional rulemaking would probably be necessary since the 10 CFR 60 licensing regulations apply only to mined geologic disposal of HLW, and the 10 CFR 61 licensing regulations apply only to LLW disposal. Since rulemaking, NRC licensing, and statutory authorization will all be complex and time-consuming processes, the evolving regulatory regime for radioactive

(a) These regulations are also promulgated under the authority of the AEA and the Energy Reorganization Act.

waste disposal should be tracked in the development of SST waste management strategies.

4.2.5 10 CFR 60, Disposal of High-Level Radioactive Wastes in Geologic Repositories

The relevant NWPA implementing regulations are contained in 10 CFR 60, "Disposal of High-Level Radioactive Wastes in Geologic Repositories." These regulations discuss disposal of HLW in geologic repositories and contain standards that are relevant to SST waste management decisionmaking. The regulations prescribe rules governing the licensing of the DOE to receive and possess source, special nuclear, and byproduct material at a geologic repository operations area that is sited, constructed, or operated in accordance with the NWPA.

4.2.6 Low-Level Radioactive Waste Policy Act of 1980 (LLRWPA)

While the LLRWPA is not directly applicable to SST waste management decisions, some of the implementing regulations may be useful in evaluating disposal options. The LLRWPA (42 USC 2021b et seq.) requires that each state dispose of LLW generated within the state or outside the state under compacts with other states. The LLRWPA was amended in 1985 to make the disposal of "greater than Class C" (GTCC) LLW a federal responsibility. The relevant implementing NRC implementing regulations for LLW are available at 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste."(a)

4.2.7 10 CFR 61, Licensing Requirements for Land Disposal of Radioactive Wastes

The regulations in 10 CFR 61 set forth licensing requirements for land disposal of LLW. They establish the procedures, criteria, and terms and conditions upon which the NRC issues licenses for the land disposal of radioactive wastes containing byproduct, source, and special nuclear material received from other persons. (Disposal of waste by an individual licensee is set forth in Part 20.) The regulations do not apply to:

(a) These regulations are also promulgated under the authority of the AEA and the ERA.

- disposal of HLW as provided for in 10 CFR 60
- disposal of uranium or thorium tailings or wastes as provided for in 10 CFR 40 in quantities greater than 10,000 kilograms and containing more than five millicuries of ^{228}Ra
- disposal of licensed material as provided for in 10 CFR 20.

The 10 CFR 61 regulations contain specific technical requirements for near-surface disposal of radioactive waste, which involves disposal in the uppermost 30 m of the earth's surface. However, the regulations also state that burial deeper than 30 m may also be satisfactory and that technical requirements for alternative methods will be added in the future. The regulations also include radionuclide concentration limits to be used in determining whether a waste is suitable for near-surface disposal.

4.2.8 Safe Drinking Water Act (SDWA)

While the SDWA and its implementing regulations are not directly applicable to SST waste management decisions, their groundwater protection requirements and standards for protecting drinking water supplies may be used as relevant technical standards to ensure that groundwater protection is appropriately considered. Groundwater protection requirements are covered in a number of statutes and regulations. Both RCRA and SDWA have provisions for regulating groundwater pollution. The SDWA specifically protects groundwater through the sole source aquifer program, the wellhead protection program, and the underground injection program as such injection affects underground sources of drinking water. Many of the RCRA regulatory limits are derived from the SDWA; therefore, a discussion of SDWA is included in this report. The SDWA's MCLs may also serve as "substitute" criteria for measuring compliance with the RCRA qualitative groundwater protection requirements. (RCRA numerical criteria for a few hazardous waste constituents are available in Appendix III of 40 CFR 265.)

The purpose of the SDWA and its 1986 amendments (42 USC 300f et seq.) is to protect public health by protecting drinking water sources. The implementing regulations applicable to drinking water include the National Primary and Secondary Drinking Water Regulations (40 CFR 141-143); the Under-

ground Injection Control Program (40 CFR 144-147); the proposed Hazardous Waste Injection Restrictions (52 FR 32446; August 27, 1987); and the Regulations for Sole Source Aquifers (40 CFR 149). The 1986 SDWA Amendments prescribe additional drinking water regulations, provide stronger enforcement authority, expand protection of sole source aquifers, and create a new program for wellhead protection. The EPA has issued an interim final rule (June 26, 1987) that prescribes criteria for use in identifying critical aquifer protection areas within aquifers designated as sole sources of drinking water (52 FR 23982).

The EPA, which is responsible for developing programs and implementing regulations, has authorized the DSHS to regulate public water supplies and has approved Ecology to manage the underground injection control (UIC) program. Ecology administers the sole source aquifer program in the State of Washington (RCW 43.21A.445). The state is planning to adopt and submit to the EPA for approval a state program to protect wellhead areas within their jurisdiction from contaminants that may adversely affect public health. EPA has provided guidance documents to the state for use in developing a comprehensive wellhead protection program.

4.2.9 Federal Water Pollution Control Act (FWPCA)/Clean Water Act (CWA)

While the CWA and its implementing regulations are not directly applicable to SST waste management decisions, regulatory standards under the CWA may be useful in developing criteria that may be used to assess the groundwater protection performance of an SST in-place disposal facility. These standards include RQs and water quality standards.

The CWA is codified in 33 USC 1251-1376. The regulations developed to implement the CWA and its amendments are available at 40 CFR 110 through 136 and 401 through 424. The objective of the CWA is to restore and maintain the integrity of the Nation's waters (defined as navigable waters). To accomplish this, the CWA requires the establishment and implementation of effluent limitations and water quality standards through the National Pollutant Discharge Elimination System (NPDES). Ecology is authorized to administer the NPDES program to regulate point source discharges to navigable waters, but, in the State of Washington, EPA has retained jurisdiction over the issuance of NPDES

permits for federal facilities. Other provisions relate to the regulation of oil and hazardous substances as they may impact navigable waters, the disposal of fill and dredge material in navigable waters, grants for the construction of treatment works, and research grants.

Waters of the state are regulated under the State of Washington Clean Water Act, which is known as the Washington Water Pollution Control Act (RCW 90.48). Unlike the federal definition for waters of the nation, waters of the state are defined to include groundwaters. The primary implementing regulations are available at WAC 173-201 through -216, -220, and -240.

5.0 WASTE CLASSIFICATIONS

The SST wastes may fall into a number of different hazardous and radioactive waste classes under RCRA, AEA, and other relevant or potentially useful statutes. The classes of waste present in the tanks will determine, in part, whether in-place disposal of some or all of the SST wastes is possible. Waste characterization programs will be designed, to the extent acceptable, to confirm or rule out the presence of those waste constituents or characteristics that would lead to a determination that in-place disposal is or is not feasible. This chapter describes the classes of waste defined in the federal and state environmental pollution control and radiation protection statutes and regulations, and in DOE Orders, that are applicable or relevant to SST waste characterization and disposal planning.

5.1 SOLID AND HAZARDOUS WASTE

Solid nonhazardous and hazardous wastes are addressed in RCRA and in the federal and state implementing regulations. An additional category, hazardous substances, as defined under CERCLA, includes hazardous substances listed under RCRA, the CWA and the CAA.

5.1.1 "Solid Waste"

Solid waste, as defined in the RCRA regulations, includes any discarded material resulting from industrial, commercial, agricultural, and social activities, including sludge, liquid, semisolid, and contained gaseous materials [40 CFR 260, App. I; 40 CFR 261.2, WAC 173-303-016(3)]. Several classes of material, such as domestic sewage and irrigation return flows, are excluded from this definition. Also excluded are source, special nuclear, and byproduct material as defined by the AEA. By definition, the SST wastes are considered to be solid waste; however, only the radionuclides in the waste are defined as byproduct material and thus exempt from RCRA regulation (see Section 5.2.1).

5.1.2 "Hazardous Waste"

Solid waste is divided into hazardous and nonhazardous waste. Hazardous waste, as described in RCRA, is solid waste that, because of its quantity, concentration, or physical, chemical, or infectious characteristics, could pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed. A solid waste is a hazardous waste if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity (i.e., it is a "characteristic waste"); and/or if it contains any of the constituents included in the lists of hazardous constituents in 40 CFR 261, Subpart D (i.e., it is a "listed waste"). In the Washington State regulations, hazardous waste is generally referred to as dangerous waste.

The lists at 40 CFR 261, Appendix VIII (Hazardous Constituents) and WAC-173-303-9905 (Dangerous Waste Constituents) are lists of chemically distinct components of a solid waste that cause the solid waste to be classified as hazardous. These chemicals include heavy-metal-based compounds and salts, aromatic hydrocarbons, halogenated hydrocarbons, solvents, herbicides and pesticides, other hydrocarbons, corrosive and caustic compounds (acids and bases), and nitrogen-based compounds.

5.1.3 "Dangerous Waste" and "Extremely Hazardous Waste"

Solid waste classified as hazardous under RCRA is generally referred to as dangerous waste in the Washington State regulations. Similar to the federal definition for hazardous waste, dangerous waste includes "listed" and "characteristic" waste; in addition, it also includes the "criteria"-designated dangerous wastes. The term "dangerous waste" at the State level, includes both EHW and DW. Any dangerous waste not designated EHW is designated DW. Solid waste can be designated as EHW if it:

- Exceeds toxicity concentration limits (including limits established for EP Toxicity, toxic mixtures, and biological toxicity)
- Contains discarded acutely hazardous chemicals (discussed below)
- Exceeds persistent and carcinogenic chemical concentration limits

- Contains wastes generated from several specific industrial processes these have not been associated with Hanford operations).

The Discarded Chemical Products List at WAC 173-303-9903 is a list of moderately dangerous chemical products and acutely dangerous chemical products; these chemical products are designated DW and EHW, respectively. The chemical products are categorized as moderately or acutely dangerous on the basis of toxicity categories D, EP toxicity, and whether they are persistent halogenated hydrocarbons, polycyclic aromatic hydrocarbons, or are carcinogenic, ignitable, or reactive.

The Dangerous Waste Sources List at WAC-173-303-9904 describes nonspecific and specific sources of DW that are subject to regulation. Specific sources include wood preservation chemicals, inorganic pigments, organic chemicals, and others. The Dangerous Waste Sources List is probably not applicable to the SSTs unless the SSTs contain polychlorinated biphenyls (PCBs) that may have been used in transformers on the Hanford Site.

5.1.4 "Hazardous Substance"

Hazardous substances are defined in both CERCLA and RCRA. In CERCLA, a hazardous substance is any substance listed in Table 302.4 at 40 CFR 302. The substances on this table include constituents that have been designated as hazardous under CWA, CAA, TSCA, and RCRA. These constituents include, for example, heavy metals and salts, radionuclides, herbicides and pesticides and their derivatives, corrosive compounds (acids and bases), and ammonium compounds.

Under the Washington RCRA program, a "hazardous substance" is any liquid, solid, gas, or sludge, including any material, substance, product, commodity, or waste, regardless of quantity, that exhibits any of the physical, chemical or biological properties described in WAC 173-303-090, -101, -102, or 103. These include "characteristic" dangerous wastes, toxic dangerous wastes, persistent dangerous wastes, and carcinogenic dangerous wastes.

5.2 "RADIOACTIVE WASTE" AND "RADIOACTIVE MIXED WASTE"

Radioactive waste is defined in DOE Orders as solid, liquid, or gaseous material of negligible economic value that contains radionuclides in excess of threshold quantities. The various categories of radioactive waste are discussed below.

5.2.1 "Byproduct Material"

The AEA defines byproduct material as:

- any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material
- the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.[a]

DOE Order 5820.2A, Radioactive Waste Management, adds that the second category of byproduct material above does not include ore bodies depleted by uranium solution extraction operations and that remain underground.

In May 1987, DOE published a final rule (10 CFR 962) that interpreted the first part of the AEA definition of byproduct material as it applies to DOE-owned or -produced radioactive waste substances that are also considered hazardous wastes under RCRA. The rule states that only the actual radionuclides dispersed or suspended in the waste substance will be considered byproduct material and thus subject to regulation under AEA. The nonradioactive hazardous component of the waste will be subject to regulation under RCRA. The effect of the rule is that each such waste will be subject to regulation under both RCRA and AEA (52 FR 15937; May 1, 1987).

(a) Source material is defined in 10 CFR 40, Domestic Licensing of Source Material, as uranium, thorium, or any combination of the two, or ores containing at least 0.05% (be weight) of any of the foregoing. Source material does not include special nuclear material, which is defined in 10 CFR 40 as plutonium, ^{233}U, uranium enriched in ^{233}U or ^{235}U, or any material artificially enriched in any of the foregoing.

5.2.2 "High-Level Radioactive Waste" (HLW)

The definition of HLW and its potential application to the SST wastes has been a topic of discussion among federal agencies for some time. A discussion of some of the legal and institutional issues affecting radioactive waste classification and in-place disposal of SST wastes is presented in this section.

As discussed previously, the ERA gave the NRC licensing and regulatory authority over DOE facilities authorized for the express purpose of long-term storage of HLW that is not used for, or is not a part of, research and development activities (42 USC 5842). At issue is the definition of HLW that should be applied to the SST wastes. The various definitions, which are found in the NRC regulations at 10 CFR 60 and 10 CFR 50, in the NWPA, and in DOE Orders, are discussed below.

The NRC regulations at 10 CFR 60 govern the licensing of DOE activities at geologic repositories for the disposal of HLW. The NRC states, in the background information accompanying its Advanced Notice of Proposed Rulemaking (ANPR) on the HLW definition, that the appropriate definition for this purpose is that in existence when the ERA was passed in 1974 (52 FR 5993; February 27, 1987). This definition is the one found in Appendix F of 10 CFR 50, Domestic Licensing of Production and Utilization Facilities, promulgated in 1970. In Appendix F, HLW was defined as "those aqueous wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuels." The 10 CFR 60 definition adopts the 10 CFR 50 definition, but adds two categories of waste that are considered HLW: 1) solids into which the liquid wastes have been converted, and 2) irradiated reactor fuel.

The NWPA defines HLW as follows:

"a) the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and

b) other highly radioactive material that the [NRC], ... determines by rule requires permanent isolation."

The definition of HLW in DOE Order 5820.2A Radioactive Waste Management, is similar to that in clause (a) of the NWPA.

In its recent notice of proposed rulemaking (NPR) on the definition of HLW, the NRC states that "... materials that are HLW for purposes of the licensing-jurisdiction provisions of the Energy Reorganization Act of 1974 (ERA) will also be regarded as HLW under NWPA. This would include the primary reprocessing waste streams at DOE facilities, though not the incidental wastes produced in reprocessing" (53 FR 17709, May 18, 1988). In its comments on the Draft Environmental Impact Statement for the Disposal of Hanford Defense High Level Transuranic and Tank Wastes (DEIS, DOE 1986)[(a)] the NRC notes that it appears that the Hanford tank wastes, which from the information presented in the DEIS would have been regarded as HLW when the ERA was passed, remain HLW for the purpose of determining whether or not the NRC has licensing and regulatory jurisdiction. It states, "If DOE believes that subsequent processing of the 'tank wastes' may have altered the classification of some of the materials being stored, more detailed waste characterization information would be necessary to support that view." It also states that it believes that establishing the feasibility of such disposal as technically adequate to protect the public health and environment will be exceedingly difficult and may not be achievable.

The NRC recommends that the wastes be characterized, to the extent practicable, by their sources in fuel reprocessing operations. It states that if, for example, certain tanks contain wastes from the operation of the first-cycle solvent extraction system, then these wastes would clearly be considered HLW. However, if some of the tanks contain predominantly incidental wastes such as cladding removal wastes or organic wash wastes, and if the radionuclide concentrations in these wastes are comparable to other LLW, these wastes might not properly be classified as HLW.

(a) The NRC's comments on the DEIS were published in Volume 5 of the HDW-EIS (DOE 1987).

In the HDW-EIS, the DOE states that the Hanford reprocessing wastes, which were stored in single-shell and double-shell tanks,[a] "have been processed and transferred among tanks to the point where some may be classed as high-level and some may not" (DOE 1987). It also notes that, "Because of fractionation and mixing, neither the single-shell nor double-shell tanks contain waste typical of HLW as initially produced by the PUREX plant" (DOE 1987). In its response to comments on the DEIS,[b] the DOE states that the SST waste has been mixed enough in the last 40 years of operations that it cannot be characterized simply by its source in the fuel reprocessing cycle and that "it is inappropriate at this time to describe the single-shell tank waste as high-level waste as defined in the [NWPA]." DOE states that it will compare tank characterization data to the applicable high-level waste definition prior to disposal decisions (DOE 1987). At this point it can be said that showing that the wastes are not characteristic of wastes from the first-cycle solvent extraction process will be important in demonstrating that the wastes should more properly be considered LLW or TRU wastes.

5.2.3 Transuranic Waste

Transuranic waste is defined in DOE Orders and in EPA regulations, but is not an NRC-defined waste class. DOE Order 5820.2A, Radioactive Waste Management, defines TRU waste as, "Without regard to source or form, radioactive waste that is contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/g at the time of assay." The Order also states that heads of DOE Field Elements can determine on a site-specific basis that other alpha-contaminated wastes must be managed as TRU wastes.

The definition of TRU waste in 40 CFR 191, Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes, is the same as the definition in

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(a) Double-shell tanks have been used for the storage of active liquids since 1970 (DOE 1987).

(b) DOE responses to comments on the DEIS were published in Volume 4 of the HDW-EIS (DOE 1987).

the DOE Order 5820.2A. However, 40 CFR 191 specifically excludes: "1) High-level radioactive wastes; 2) wastes that the DOE has determined, with the concurrence of the EPA, do not need the degree of isolation required by this part; or 3) wastes that the NRC has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61."

5.2.4 Low-Level Radioactive Waste

DOE Order 5820.2A defines LLW as, "Radioactive waste not classified as high-level waste, TRU waste, spent nuclear fuel, or [the second category of] byproduct material as defined by this Order." The NWPA defines LLW as radioactive material that is not HLW, spent nuclear fuel, TRU waste, or byproduct material as defined in the AEA; and other material that the NRC, consistent with existing law, classifies as LLW. The Low-Level Waste Policy Amendments Act (LLWPAA) of 1985 defines LLW in the same way as the NWPA, but without the reference to TRU waste.

The regulations in 10 CFR 61, Licensing Requirements for Land Disposal of Radioactive Waste, deal with LLW (as defined by the LLRWPA) containing source, special nuclear, or byproduct material that is acceptable for disposal in a land disposal facility. These wastes are divided into Class A, Class B, and Class C waste as follows:

- Class A waste is low-activity waste that is usually segregated from other waste classes at the disposal site because of its instability. (For example, ordinary trash is considered unstable in the long term.)
- Class B waste is higher-activity waste that must meet more rigorous requirements on the waste form to ensure stability after disposal. Both Class A and Class B waste contain types and quantities of radioisotopes that will decay such that they present an acceptable hazard to an intruder after 100 years.
- Class C waste is waste that not only must meet more rigorous requirements on the waste form to ensure stability but also requires additional measures at the disposal facility to protect against inadvertent intrusion. Class C waste is waste that will not decay to levels that present an acceptable hazard to an intruder within 100 years, and is disposed of at a greater depth than the other classes of waste.

The regulations in 10 CFR 61 also contain a method for classifying wastes based on specific concentrations of long-lived radionuclides (or their precur-

sors) and short-lived radionuclides. The NRC recently considered defining all GTCC waste that is highly radioactive and that requires permanent isolation as HLW (52 FR 5995; February 27, 1987). Instead, in its NPR on the HLW definition, the NRC proposed that it be required that all commercially-generated GTCC LLW be disposed of in a deep geologic repository to guarantee a disposal "home" for such waste (53 FR 17709; May 18, 1988). However, disposal elsewhere may also be approved by the NRC. The issue of regulatory authority over the disposal of GTCC LLW that is generated by the DOE is currently a matter of discussion between the DOE and the NRC. These discussions should be tracked during waste management planning for the SST wastes.

5.2.5 Radioactive Mixed Waste

An EPA Notice (51 FR 24504; July 3, 1986) addressed the authority of a state to regulate the hazardous components of radioactive mixed wastes under RCRA. It defined radioactive mixed wastes as wastes that contain hazardous constituents subject to RCRA and radioactive constituents subject to the AEA. (DOE Order 5820.2A also contains this definition for "mixed waste.") The EPA has determined that radioactive mixed waste is considered a "solid waste," and that wastes containing both hazardous waste and radioactive waste are subject to RCRA regulation. However, the radionuclides themselves are subject to regulation under AEA rather than RCRA. (The DOE has codified the same interpretation with respect to byproduct material at 10 CFR 962, discussed in Section 5.2.1 of this report.)

5.2.6 Mixed Low-Level Radioactive and Hazardous Waste

The EPA and NRC have developed joint guidance on this waste, which contains source, special nuclear, or byproduct materials and also chemical constituents that are hazardous under EPA regulations. Mixed LLW and hazardous waste is defined in the guidance as, "Waste that satisfies the definition of LLW in the Low-Level Radioactive Waste Policy Amendments Act of 1985 (LLRWPAA) and contains hazardous waste that either 1) is listed as a hazardous waste in Subpart D of 40 CFR Part 261 or 2) causes the LLW to exhibit any of the hazardous waste characteristics identified in Subpart C of 40 CFR Part 261" (OSWER 1987).

6.0 ENVIRONMENTAL PERMITS

The SSTs contain radioactive mixed waste and may be subject to an EPA or state permit(s). This chapter presents a generic discussion of the applicable or relevant permits prescribed by the statutes and regulations described in Chapter 4.0. The RCRA and CAA permits are expected to be applicable to developing waste management strategies for the SSTs; however, other permits and permit-like requirements that are not expected to be required are briefly discussed here to familiarize the reader with the regulatory permitting domain and the interrelationships among these environmental permits. These permits are based upon performance and design requirements presented in the regulations. Specific performance and design requirements are discussed in Chapter 7.0. In addition, permit-like requirements are also presented here.

6.1 ENVIRONMENTAL PERMITS

6.1.1 Resource Conservation and Recovery Act of 1976 (RCRA)

The Hanford Site is currently operating under RCRA interim status. Under interim status, a hazardous waste management facility may continue to operate if it complies with the regulatory requirements, including performance and design criteria, in 40 CFR 265. General requirements for permits to treat, store, or dispose (TSD) of hazardous waste regulated under RCRA are found in Section 3005 of RCRA, 40 CFR 270, and WAC 173-303-806. The RCRA permit application consists of two parts, A and B. The Part A application, which is generally quite brief, includes a description of the processes used for treatment, storage, and disposal of hazardous waste. The capacities of each of the units (e.g., tanks, surface impoundments, etc.) and an estimate of the quantity and description of the particular types of hazardous waste must be included in the Part A application. The Part B application is quite extensive and must include security procedures, contingency plans, a description of the facility, closure and postclosure plans, and chemical, physical, and biological analyses of the hazardous waste. (See 40 CFR 270.14 for a more detailed description of the Part B requirements.) The DOE will be submitting Part B applications and seeking final RCRA permits to continue operating some Hanford

units. Other units, such as the SSTs, will be submitting closure and post-closure plans and will not seek a final operating permit.

The applications and plans described above are submitted to Ecology. Ecology has received authority from EPA to administer some, but not all, of the 1984 HSWA amendments to RCRA.

Even though the DOE will probably not seek a final RCRA permit for the SSTs, the Part A application for the SSTs has been submitted and closure and postclosure plans will be submitted to close the SSTs under RCRA. Waste characterization information was included in the Part A application. As required, a specification of the hazardous wastes to be treated, stored, or disposed of at the facility, an estimate of the quantity of such wastes, and a general description of the processes was included. As additional information from waste characterization activities is gathered, this application will be updated.

The SST system closure/corrective action plan, a precursor to a closure plan, will be submitted in 1989. The closure plan must include a description of how the facility will be closed to meet the closure performance standards (see Section 7.1.1), an estimate of the maximum inventory of hazardous wastes, a description of the steps needed to remove or decontaminate hazardous wastes and soils, and criteria for determining the extent of decontamination necessary to satisfy the closure performance standards. A detailed description of the groundwater monitoring system is also necessary. In addition, if the SSTs are closed as a landfill under RCRA, the landfill design requirements must be met. At final closure, the landfill must be covered with a final cover designed and constructed to provide, among other items, long-term minimization of liquid migration through the closed landfill, and to promote drainage, accommodate settling and subsidence so that the cover's integrity is maintained, and have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present (40 CFR 265.310).

The postclosure plan must identify and describe the activities, such as groundwater monitoring, that will be carried out after closure. This plan must also describe the frequency of these activities.

6.1.2 Clean Air Act (CAA)

A variety of permits, approvals, and notices associated with limits for air emissions may be required under the CAA (40 CFR 61.07). First, an approval of construction is required if new facilities are constructed, or if the existing facilities are modified. Any physical or operational change to a tank that results in an increase in the rate of radionuclide emission would be considered a modification [40 CFR 61.15(a)]. Routine maintenance and repair is not a modification [40 CFR 61.15(d)(1)]. To obtain this approval, information must be provided to EPA on the nature of the emissions from the facility and the associated control devices [40 CFR 61.94(b)].

Secondly, facilities, including tanks, that are sources of radionuclide emissions must be registered with the DSHS [WAC 402-80-060(b)]. The DSHS is to be notified prior to replacement of radioactive emission control equipment or process equipment other than replacement for routine maintenance and repair [WAC 402-80-070(2)]. The DSHS needs to approve construction of new facilities with radionuclide emissions [(WAC 402-80-070(1)]. Such approval may also be required for significant modifications or replacements to existing facilities.

Thirdly, existing facilities, including tanks, should be registered with the Benton-Franklin-Walla Walla Counties Air Pollution Control Authority if they have emissions regulated under 40 CFR Part 61.[(a)] This requirement is part of the new source review process. The registration form calls for information concerning location, size and height of contaminant outlets, processes employed, and the nature of the contaminant emissions. A closure report is to be filed with the Authority when operations permanently cease.

Fourthly, the CAA contains provisions designed to prevent significant deterioration of air quality and requires new "major emitting facilities" to obtain a PSD permit that sets forth emission limitations. The term "major emitting facilities" includes certain stationary sources with the potential to emit 100 short tons per year (tpy) of any air pollutant and all other sources

(a) General Regulation 80-7, Section 400-100(21).

with the potential to emit 250 tpy of any pollutant. This permit is not applicable to SST waste management decisions.

6.1.3 Safe Drinking Water Act (SDWA)

While not directly applicable to SST waste management decisions, the drinking water standards under the SDWA may serve as "substitute" criteria for assessing the degree of groundwater protection inherent in alternative waste management strategies. In addition, the 1986 Amendments to SDWA provide authority for special programs to protect aquifers and drinking water wellfield areas. Federal and state guidance for groundwater protection under these programs is currently evolving and should be monitored for criteria that may be useful to SST waste characterization and management decisions.

Because no injection wells will be constructed under the SST program to dispose of waste fluids, the UIC program is not applicable to SST activities; however, a brief discussion of the UIC program is provided here.

Under the SDWA, permits are required for certain classes of underground injection wells. In general, wells must either be permitted or qualify for a permit-by-rule. No injection will be permitted if it results in the movement of fluid containing any contaminant into underground sources of drinking water (USDWs) (WAC 173-218-030) or into USDWs or potential USDWs (40 CFR 144.3), and if the presence of that contaminant may cause a violation of any primary drinking water regulation (40 CFR 142) or may adversely affect the health of persons [40 CFR 144.12; WAC 173-218-100(2)].

6.1.4 Federal Water Pollution Control Act (FWPCA)/Clean Water Act (CWA)

While not directly applicable to SST waste management decisions, regulatory standards under the CWA may be useful in developing criteria that can be used to assess the groundwater protection. This Act establishes two permits, the NPDES Permit and the Fill and Dredge Permit.

The NPDES program requires permits for the discharge of "pollutants from any point source into waters of the United States" [40 CFR 122.1(b)]. Similarly, Washington State specifies that no pollutants or other wastes or substances from any point source may be discharged directly to any water of the

state unless authorized by a permit (WAC 173-220). Washington's definition of water of the State includes both surface waters and groundwater (unlike the federal definition for waters of the United States that are generally referred to as navigable waters); therefore, unlike the federal CWA, the State CWA is applicable to groundwaters. Washington has been authorized to administer the NPDES program; however, EPA has retained the authority to issue NPDES permits to federal facilities in Washington.

Permits are also required for the discharge of dredged or fill material into waters of the United States (33 USC 1344). At the present time, none of the activities associated with the SST project will involve the disposal of fill or dredge material to the Columbia River; therefore, a detailed discussion of fill and dredge permit criteria is not included here.

A third permit, the State Waste Discharge Permit, is established by the Washington Water Pollution Control Act. This permit prevents and controls the discharge of wastes into waters of the state. The permit terms and conditions prescribed in the regulations (WAC 173-216-110) are broad. Specific criteria, terms and conditions of a permit are subject to negotiation between Ecology and the permittee.

6.2 PERMIT-LIKE REQUIREMENTS

6.2.1 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

Because the RCRA corrective action requirements are similar in principle to CERCLA's cleanup provisions, an understanding of the CERCLA requirements may be useful in developing waste characterization strategies (Friedman 1987). CERCLA and its implementing regulations contain permit-like requirements that are concerned with the presence of hazardous substances at facilities and releases of hazardous substances.

For the cleanup of releases, neither removal actions nor remedial actions require federal, state, or local permits. However, the regulations stipulate that remedial actions involving storage, treatment, or disposal of hazardous substances, pollutants, or contaminants at offsite facilities shall involve

only facilities that are operating under appropriate federal or state permits or authorization and other legal requirements [40 CFR 300.68(a)(3)].

6.2.1.1 Hazardous Substances at Facilities

Section 103(c) of CERCLA stipulates that an owner or operator of a facility at which CERCLA-defined hazardous substances are or have been stored, treated, or disposed of shall notify EPA of the existence of the facility, specifying the amount and type of any hazardous substance to be found there and any known, suspected, or likely releases of such substances from the facility.

6.2.1.2 Relationship of CERCLA to Other Permits

CERCLA excludes "federally permitted releases" from notification/reporting requirements. The CERCLA definition of federally permitted releases includes discharges in compliance with permits or authorizations issued under CWA, SDWA, RCRA, and CAA. If discharges are permitted under one of these statutes, the "permit" holder is exempt from the CERCLA reporting requirements for that particular discharge.

6.2.2 Emergency Planning and Community Right-to-Know Act (EPCRA)

EPCRA does not contain any permit requirements, or any permit-like requirements, that are important to SST waste characterization and management.

6.2.3 Washington Hazardous Waste Cleanup Act

As discussed in Section 4.4, the policy and regulations for implementing this Act are yet to be developed and may be important to waste management strategies. This Act specifically discusses exemptions from permits. A person conducting a remedial action under an approved settlement agreement is exempt from the Washington permits and permit-like requirements of the CAA (RCW 70.94), the Hazardous Waste Management Act (RCW 70.105), the Water Code-1917 Act (90.03), the Regulation of Public Groundwaters Act (RCW 90.44), the Water Pollution Control Act (RCW 90.48), the Shoreline Management Act (RCW 90.58), and the State Environmental Policy Act (SEPA) (RCW 43.21C). In addition, the Washington Hazardous Waste Cleanup Act is not applicable to any sites, such as areas of Hanford, that have been nominated to CERCLA's national priorities

list (NPL); however, requirements of the Act may be used as guidance in making SST waste management decisions.

7.0 PERFORMANCE AND DESIGN CRITERIA

This chapter discusses environmental pollution control and radiation protection requirements that may be applicable or relevant to the performance and design of SST waste characterization and disposal systems. The regulatory-based requirements include design and operational requirements as well as preclosure and postclosure performance requirements and criteria.

Performance and design requirements are those requirements that a final waste disposal system must meet. The performance requirements range from very quantitative (such as radiation dose limits for the general public) to very qualitative (such as requirements to protect the environment). The design requirements are generally very specific and include requirements such as those to provide a landfill cover that will prevent intrusion.

As noted, the statutes and regulations assessed for this report contain both specific quantitative requirements and general, qualitative requirements. In some instances, specific numerical criteria by which compliance with qualitative requirements can be measured are not given in the regulations. In such cases, it is sometimes possible to identify numerical criteria from other regulations that might be used in performance assessments as "substitute" measures of whether qualitative goals are being achieved, even though the criteria are not strictly applicable. Where available and appropriate, such substitute criteria are identified.

7.1 RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

The DOE has determined that its radioactive wastes that are also hazardous wastes under RCRA will be subject to regulation under both RCRA and AEA, with RCRA yielding to AEA where inconsistencies arise [52 FR 15937; May 1, 1987 (see Section 5.2.7 of this report)]. "Inconsistencies" have been described as situations where satisfying both RCRA and AEA regulations would increase the radiation hazard, would be technically infeasible, or would violate national security interests (OSWER 1987). For example, some waste sampling and analysis activities required under RCRA might be waived if the need to identify certain hazardous constituents were outweighed by the occupational radiation doses

that would be incurred during the activities. Thus, the DOE requirement to maintain occupational exposures as low as reasonably achievable will be one factor in determining the degree of SST waste characterization that is feasible. Such factors will drive the need to develop a waste characterization plan that is as efficient as possible, while providing the information necessary for waste disposal decisionmakers.

Given the DOE's interpretation, to the extent that hazardous wastes are present in the SSTs, the RCRA regulatory requirements for designing, constructing, operating, and maintaining HWM facilities would apply to any SST in-place disposal system. (These standards apply to waste facilities permitted under WAC 173-303-800 through 173-303-840.) This section describes the performance and design requirements and criteria identified in the RCRA regulations for hazardous waste management facilities.

7.1.1 Requirements for Hazardous Waste Management Facilities

This subsection discusses general performance, design, and closure requirements that apply to all hazardous waste management facilities. RCRA corrective action requirements, which are triggered upon the release of hazardous waste from hazardous waste management facilities, are also described. These requirements and criteria are, for the most part, qualitative. The subsection also discusses more specific requirements and criteria for landfills, which are one type of hazardous waste management facility. Under some waste management scenarios being considered, the SSTs would be closed as RCRA landfills. If so, the requirements and criteria discussed in this subsection would apply to the tanks.

Performance and Design Requirements

Washington State imposes general performance criteria on dangerous waste management facilities at WAC 173-303-430. The regulation requires that, unless authorized by state, local, or federal laws, or unless otherwise authorized in the regulation, such facilities must be designed, constructed, operated, and maintained to prevent, to the maximum extent practical given the limits of technology:

- degradation of groundwater quality

- degradation of air quality by open burning or other activities
- degradation of surface water quality
- destruction or impairment of flora and fauna outside the active portion of the facility
- excessive noise
- conditions that constitute a negative aesthetic impact for the public using rights of way, or public lands, or for landowners of adjacent properties
- the use of processes that do not treat, detoxify, recycle, reclaim, and recover waste material to the extent economically feasible
- endangerment of the health of employees, or of the public near the facility.

In addition to the general performance requirements listed above, RCRA regulations also contain specific design-oriented requirements for various types of facilities, including landfills. These requirements may be important in determining whether in-place disposal of the SST wastes is feasible. In addition, the regulations contain operational requirements that may be relevant to the design of technologies and procedures for waste retrieval and processing. These include handling requirements for ignitable, reactive, or incompatible wastes. These requirements are not described here, but may be found at 40 CFR 264.17.

If the SSTs were closed as landfills, the landfill closure and postclosure care standards described under 40 CFR 265 and WAC 173-303 would apply to the SSTs [WAC 173-303-640(8)]. The operating standards are also given here to provide a comprehensive overview of the landfill regulations that are important to SST waste management and disposal decisions.

Landfills fall into a class of hazardous waste management facilities called "regulated units." The regulations governing this class of facilities require that, except for the existing portions of a landfill, regulated units have a liner for all portions of the unit. The liner must be designed, constructed, and installed to prevent any migration of waste out of the unit to the adjacent subsurface soil, groundwater, or surface water at any time during

the active life of the unit (WAC 173-303-665). The liner must be constructed of materials that have appropriate chemical properties and sufficient mechanical strength to prevent failure due to pressure gradients, physical contact with the waste or leachate, climatic conditions, stresses of installation, and stress associated with operation. The liner must be placed on a foundation or base capable of providing support to the liner. All surrounding earth that is likely to be in contact with the waste or leachate must be protected by the liner (40 CFR 264.211, 264.251, and 264.301).

In addition to the landfill design requirements described above, the placement of bulk liquids in landfills is prohibited under section 3004(c) of RCRA, which states that, after 1984, the placement of bulk or noncontainerized liquid hazardous waste or free liquids contained in hazardous waste (whether or not absorbents have been added) in any landfill is prohibited. Additional requirements governing the placement of liquid waste in landfills are found in 40 CFR 264.314 and WAC 173-303-665(9).

The Washington Hazardous Waste Management Act (RCW 70.105) includes provisions for Ecology to use federal government property at Hanford as an EHW disposal site (RCW 70.105.040). Disposal of EHW at any site other than one that was to be established by Ecology was prohibited (RCW 70.105.050). Since Ecology has not yet established the EHW disposal facility at Hanford, all land disposal of EHW in Washington has been effectively prohibited. However, since RCW 70.105.040 is active and in effect, Ecology still retains the authority to develop an EHW disposal site at Hanford.

On July 26, 1987, RCW 70.105.050 was amended to allow for the disposal of EHW that contains radioactive components at radioactive waste disposal sites owned by the DOE or licensed by the NRC.[(a)] Such disposal sites must receive permits from Ecology and must be operated in compliance with RCW 70.105. Prior to disposal and during the disposal process, every reasonable effort must be made to mitigate the hazards associated with the mixed EHW. One

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(a) On November 23, 1987, the State of Washington received final authorization from the EPA to implement this amendment and to regulate radioactive mixed wastes (52 FR 35556; September 22, 1987).

implication of this amendment is that land disposal of EHW that contains radionuclides may be permitted on DOE land if the disposal activities comply with the requirements of RCW 70.105.

The SSTs may contain certain hazardous wastes that are restricted from land disposal under RCRA (40 CFR 268). The 1984 amendments to RCRA prohibited the land disposal of liquid hazardous wastes containing free cyanides and those liquid hazardous wastes containing metals. As of November 8, 1986, spent solvent wastes, such as methylene, chloride, and carbon tetrachloride, were prohibited from land disposal while dioxin-containing wastes will be banned as of November 8, 1988. In addition, these wastes cannot be stored unless storage is solely for the purpose of the accumulation of such quantities of hazardous waste as necessary to facilitate proper recovery, treatment, or disposal (40 CFR 268.50).

EPA has promulgated regulations restricting land disposal of certain "California list" wastes. These wastes include liquid hazardous wastes containing PCBs above specified concentrations and hazardous wastes containing halogenated organic compounds (HOCs) above specified concentrations (52 FR 25760, July 8, 1987). On April 8, 1988, EPA published a proposed rule containing land disposal restrictions for the first third of the wastes listed in 40 CFR 268 Subpart B. Additional proposed rules on land disposal restrictions are scheduled to be published in 1989. For example, the second one-third of the hazardous wastes subject to land disposal restrictions was published as a proposed rule on January 11, 1989 (54 FR 1056).

Petitions to allow land disposal of any prohibited wastes may be submitted to EPA as specified in 40 CFR 268.6. These petitions must demonstrate that there will be no migration of hazardous constituents from the disposal unit for as long as the hazardous wastes remain. In addition, a waste analysis that describes the physical and chemical characteristics of the waste along with a comprehensive characterization of the background air, soil, and water quality must be provided.

On February 5, 1988, amendments to WAC 173-303-140, "Land Disposal Restrictions" (formerly entitled "Land Disposal of Extremely Hazardous Waste") were

issued. Amendments were also made to WAC 173-303-170, -280, -400, -665, and -910 to facilitate the implementation of the new land disposal restrictions. The changes to these regulations do not refer to radioactive mixed waste, and they do not appear to include the provisions in the amendatory section of RCW 70.105.050. Instead, WAC 173-303-140 identifies dangerous wastes that are restricted from land disposal and describes procedures by which restricted waste may be authorized for land disposal. Thus, these regulations, which are applicable to hazardous waste management facilities, may be important to SST waste management decisions.

Much of the text in the amendatory section of WAC 173-303-140 was borrowed from WAC 173-303-665, which addresses landfill restrictions for ignitable, reactive, incompatible, and bulk or noncontainerized liquid waste. In addition, the amendatory section includes three new waste classifications that were developed with supporting land disposal restrictions. These new regulations do not affect the designation of wastes, but they do impose additional requirements on how to dispose of DW and EHW. The three new waste classifications are described briefly below:

- leachable inorganic waste - solid noncarbon containing waste that demonstrates the characteristic of EP toxicity as described in WAC 173-303-090(8)
- organic/carbonaceous waste - DW for which more than 10% of the constituents are carbon-containing compounds
- solid acid waste - DW that exhibits low pH as described at WAC 173-303-090(6)(a)(ii) or WAC 173-303(6)(a)(iii).

Generators of the three classes of wastes described above are encouraged to reclaim, recycle, recover, treat, detoxify, neutralize, or otherwise process these wastes to reduce their harmful properties. Unless exclusions are granted (as provided for in WAC 173-303-140), land disposal of untreated leachable inorganic, organic/carbonaceous, and solid acid waste is prohibited. If no exclusions are obtained, at a minimum, organic/carbonaceous waste must be incinerated, and leachable inorganic waste must be stabilized (solidified) before land disposal is permitted. No minimum requirements for treatment of solid acid waste are specified in the regulations.

Petitions for exclusion from the land disposal restrictions for DW and EHW may be submitted to Ecology as specified in WAC 173-303-910(6). A waste analysis that completely describes the chemical and physical characteristics of the waste is required as part of the petition [WAC 173-303-910(6)(a)(vi)]. If the generator can demonstrate that prescribed waste management techniques would impose an unreasonable economic burden relative to the threat to human health and the environment, then Ecology may grant an economic hardship exemption. If stabilization does not significantly reduce the hazards associated with leachable inorganic waste, or if stabilization technology does not exist, the generator may seek a land disposal exemption. Similarly, a petition may be submitted for exempting organic/carbonaceous waste if alternative management practices will not reduce the potential hazard, or if the heat content of the waste is less than 3000 BTU/lb [WAC 173-303-140(6)]. If there is a potential for the dangerous waste constituents to migrate from the land disposal site, Ecology may deny the petition [WAC 173-303-140(6)].

Closure Requirements

RCRA regulations contain general performance requirements for closure of all HWM facilities. These regulations require the owner or operator of a HWM facility to close the facility in a manner that:

- minimizes the need for further maintenance
- controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, postclosure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere (40 CFR 264.111).

Although a written closure plan, which includes a detailed description of how these performance standards will be satisfied (groundwater monitoring, leachate collection, etc.) is required (40 CFR 264.112), no numerical criteria against which to evaluate compliance with these standards are provided in the regulations (see Section 6.1).

At final closure, landfills being closed under interim status must have a cover designed and constructed to:

- provide long-term minimization of migration of liquids through the closed landfill
- function with minimum maintenance
- promote drainage and minimize erosion or abrasion of the cover
- accommodate settling and subsidence so that the cover's integrity is maintained
- have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.

After final closure, the owner or operator must comply with all postclosure requirements contained in the regulations including maintenance and monitoring throughout the postclosure care period. The integrity and effectiveness of the final cover, and a groundwater monitoring system must be maintained (40 CFR 265.310).

In addition, the Washington State regulations require that the land be returned to the appearance and use of surrounding land areas to the degree possible given the nature of the previous dangerous waste activity (WAC 173-303-610). Regulations also specify that postclosure care, which consists of maintenance, monitoring, and possible corrective action for releases, will continue for 30 years or longer, if necessary, to protect human health and the environment [40 CFR 264.117, WAC 173-303-610(7)].

Where closure requirements call for the removal or decontamination of DW, waste residues, or equipment, bases, liners, soils, or other materials containing or contaminated with DW or waste residue, the removal or decontamination must assure that levels of DW constituents or residues do not exceed:

- background environmental levels for "listed" and "characteristic" wastes
- designation limits.

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of a landfill, the unit must be covered with a final cover designed and constructed to:

- function with minimum maintenance
- promote drainage and minimize erosion or abrasion of the cover
- accommodate settling and subsidence so that the cover's integrity is maintained
- have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present [WAC 173-303-665(6)]:

Postclosure requirements include requirements for maintenance and monitoring to ensure the effectiveness of the final cover and to correct the effects of settling, subsidence, and erosion. A groundwater monitoring program is also necessary for compliance [WAC 173-303-665(6)].

Corrective Action Requirements

In addition to performance, design, and closure requirements, RCRA includes corrective action requirements under sections 3004(u) and (v) that build upon the CERCLA concepts of release mitigation. Releases that require RCRA corrective action are those associated with facilities that are seeking or have received a RCRA permit. Any leaks or spills associated with the SSTs are regulated under these requirements. The corrective action process described below is similar to removal and remediation conducted under CERCLA for inactive waste sites.

In the event of a release of hazardous waste, all hazardous waste management facilities must comply with 40 CFR 264.101, which contains the following requirements:

- The owner or operator of a facility seeking a permit for the treatment, storage, or disposal (TSD) of hazardous waste must institute corrective action as necessary to protect human health and the environment for all releases of hazardous waste or constituents from any solid waste management unit at the facility, regardless of the time at which waste was placed in such unit.
- Corrective action will be specified by EPA in the permit. The permit will contain schedules of compliance for such corrective action (where such corrective action cannot be completed prior to issuance of the permit) and assurances of financial responsibility for completing such corrective action. (It should be noted that TSD permits are issued by Ecology; however, because Ecology has not yet been authorized to implement the

corrective action requirements, EPA will maintain these permit requirements.)

In WAC 173-303-145, a hazardous waste management facility is required, upon release of hazardous waste to the environment, to immediately notify the appropriate authorities and to take action to protect human health and the environment. In addition, the facility responsible for the discharge may be required to clean up all released hazardous waste and treat, store, or dispose of all contaminated materials, water, or soil.

More specific requirements exist for regulated units, which include landfills. In the event of a release of hazardous waste from a unit that receives hazardous waste after July 26, 1982, compliance with 40 CFR 264.91 through 264.101 and WAC 173-303-645, groundwater monitoring requirements, is required. Whenever the concentration of any hazardous constituent specified in the facility permit is exceeded at the compliance point,[(a)] corrective action is required. The corrective action must prevent hazardous constituents from exceeding their respective concentration limits at the compliance point by removing the hazardous waste constituents or by treating them in place [40 CFR 264.100 and WAC 173-303-645(11)]. A compliance monitoring program must also be implemented [40 CFR 264.99 and WAC 173-303-645(10)].

7.1.2 Requirements for Tank Systems

Regulations for tank systems that are used for waste treatment or storage include requirements for the design, operation, closure, and postclosure care of the tanks. Under the closure and postclosure care requirements, an SST system closure/corrective action work plan will be submitted to Ecology in

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(a) Ecology will specify in the facility permit the point of compliance at which the groundwater protection standard applies and at which monitoring must be conducted. The point of compliance is a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units. Alternatively, the point of compliance may be any closer points identified by Ecology, considering the risks of the facility, the wastes and constituents, potential for migration past the alternate compliance point, and potential threats to ground and surface water.

1989. Performance and design standards for existing tank systems are briefly summarized below.

Assessments of an operating tank system are required to be performed to demonstrate that the tank system is not leaking or unfit for use and is designed to prevent collapse, failure, or rupture (40 CFR 264.191, WAC 173-303-640(2)(c) and 265.191). At a minimum, these assessments must consider:

- design standards to which the tank was constructed
- dangerous characteristics of the wastes
- existing corrosion protection measures
- age of the tank system
- results of leak test and inspections.

For nonenterable underground tanks, the assessment must include a leak test that takes into account the effects of temperature variations, tank end deflection, vapor pockets, and high water table effects [WAC 173-303(c)(2)(c)].

If a tank system is found to be leaking or unfit for use, it must be removed from service immediately, and the following requirements must be satisfied:

- prevent addition of wastes
- remove waste
- contain visible releases to the environment
  - prevent further migration of the leak to soils and surface water
  - remove and properly dispose of any visible contamination of the soil or surface water [WAC 173-303(7)].

Secondary containment systems for all existing tanks used to store Dangerous Waste Numbers F020-F023, F026, and F027 will be required within 2 years after January 12, 1989 for tanks that have reached 15 years of age. The containment system must be designed, installed, and operated to prevent any migration of wastes or accumulated liquid out of the system to the soil, groundwater, or surface water. In addition, the containment system must be

capable of detecting and collecting releases and accumulated liquids. Secondary containment for tanks must include one or more of the following devices:

- a liner (external to the tank)
- a vault
- a double-shell tank, or
- an equivalent device as approved by Ecology [WAC 173-303(4)].

External liner systems must have the capacity to contain one hundred percent of the capacity of the largest tank within its boundary and be designed and constructed in a manner that will prevent migration of contaminants to soil or groundwater.

A variance from secondary containment may be obtained if the owner or operator demonstrates that alternative design and operating practices, together with location characteristics, will prevent the migration of dangerous wastes into the groundwater, or surface water at least as effectively as secondary containment. In addition, a variance may be granted if in the event of a release that does migrate to groundwater or surface water, no substantial present or potential hazard will be posed to human health or the environment. In deciding whether to grant a variance based on a demonstration of equivalent protection of groundwater and surface water, Ecology will consider:

- nature and quantity of the wastes
- proposed alternate design and operations
- hydrogeologic setting
- all other factors that would influence the quality and mobility of the dangerous constituents.

In deciding whether to grant a variance based on a demonstration of no substantial present or potential hazard, Ecology will consider:

- the potential adverse effects on groundwater, surface water, and land quality including
  - physical and chemical characteristics of the waste, including its potential for migration

- hydrogeological characteristics
- potential for health risks caused by human exposure to waste constituents
- potential for damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents
- persistence and permanence of potential adverse effects

- potential adverse effects on groundwater quality, taking into account:
  - quantity and quality of groundwater and the direction of groundwater flow
  - proximity and withdrawal rates of groundwater users
  - current and future uses of groundwater in the area
  - existing quality of groundwater, including other sources of contamination and their cumulative impact on the groundwater quality
- potential adverse effects on surface water quality, considering:
  - quantity and quality of groundwater and the direction of groundwater flow
  - patterns of rainfall
  - proximity of tank system to surface waters
  - current and future uses of surface waters in the area and any water quality standards established for those surface waters
  - existing quality of surface water
- potential adverse effects of a release on the land surrounding the tank system, taking into account:
  - patterns of rainfall
  - current and future uses of the surrounding land.

If a variance is granted for a tank system at which a release of dangerous waste has occurred, and has migrated beyond the zone of engineering control, the contaminated soil must be removed. If contaminated soil cannot be removed or decontaminated, or if groundwater has been contaminated, the tank system must be closed in accordance with the closure and postclosure care requirements

that apply to landfills [see WAC 173-303-665(6)]. In addition, for the purposes of closure and postclosure, such a tank system is then considered to be a landfill. The closure and postclosure care requirements were discussed under "Closure Requirements" of this section.

7.1.3 Requirements for Miscellaneous Units

While not applicable to SSTs, the Subpart X regulations allow the use of performance standards that may be useful to SST waste management decisions. EPA has promulgated a set of standards under Subpart X of 40 CFR 264 that apply to new and existing hazardous waste management units not covered under existing requirements for containers, tanks, surface impoundments, waste piles, land treatment units, landfills, incinerators, underground injection wells, boilers, and industrial furnaces (52 FR 46946, December 10, 1987).

The Subpart X regulations do not contain specific design or operating standards. Because it is the intent of this Subpart to regulate diverse and innovative treatment, storage and disposal units, EPA determined that it is not possible to establish uniform requirements that would be appropriate and comprehensive for every miscellaneous unit. Consequently, standards for design, operation, technical performance, and environmental performance will be established on a case-by-case basis by the owner/operator and EPA. This concept may be useful to SST waste management decisions.

The focus of the new Subpart X regulations is upon environmental performance standards. Under these regulations, permit applicants must perform facility-specific risk assessments based on the RCRA goal of protecting human health and the environment. The risk-assessments must address protection of the groundwater, surface water, soil, and air quality. However, if the assessment demonstrates that the miscellaneous unit will not affect a specific medium, then it will not be necessary to include a plan to protect that medium in the permit. Since the regulations for tanks and landfills may not address all concerns associated with the SSTs, a risk assessment approach, like that outlined under Subpart X, may be useful in making SST waste management decisions.

In addition to the risk assessments, environmental performance standards

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numerical performance requirements necessary to protect human health and the environment. These standards may include numerical exposure specifications (such as the allowable concentration of a chemical at the points of human exposure), pollutant concentrations permitted to be released to the environment, or general objectives or goals to serve as a guide for protecting human health and the environment.

7.1.4 Requirements for Underground Storage Tanks

The EPA has proposed new technical requirements for USTs that contain specific tank design guidance for meeting storage and closure requirements. At closure, all tanks that are taken out of service permanently must be emptied and either removed from the ground or filled with an inert solid. Even though these would not apply to hazardous waste tanks regulated under Subtitle C of RCRA, these UST standards may incorporate some elements of these proposed UST rules and thus they are of interest to SST waste management decisions (52 FR 12785; April 17, 1987).

7.2 CLEAN AIR ACT (CAA)

Section 112 of the CAA (42 USC 7412) authorizes the EPA to establish emission standards for hazardous air pollutants. These standards appear at 40 CFR 61. General provisions applicable to all sources of air pollutants determined by EPA to be hazardous are at 40 CFR 61, Subpart A. Subpart H of Part 61 contains a national emission standard for radionuclide emissions from DOE facilities. [However, the provisions of Subpart H are not applicable to DOE facilities regulated under 40 CFR 190, 191, or 192 which set dose limits for all pathways.] Cumulative emissions of radionuclides to air from DOE

Section 112(d) of the CAA authorizes EPA to delegate enforcement of emission standards for hazardous air pollutants. The authority to implement and enforce Subpart H has not been delegated to the State of Washington.(a) DOE has determined that a state may regulate radionuclide emissions from federal facilities even though it has not been delegated authority from EPA under Section 112(d).(b)

The State of Washington's requirements for radionuclide emissions from DOE facilities are administered by Ecology and the DSHS. Ecology has a standard that limits emissions of radionuclides in the air from all sources to that amount that causes a maximum accumulated dose equivalent of 25 mrem/yr to the whole body or 75 mrem/yr to a critical organ of any member of the public (WAC 173-480-040). Doses due to ^{220}Rn, ^{222}Rn, and their respective decay products are excluded from these limits. The Ecology also requires that every reasonable effort be made to maintain radioactive emissions as low as is reasonably achievable. Maintaining emissions at ALARA levels can be met by installing reasonably available control technology (RACT)(WAC 173-480-050). RACT provides for the lowest emission limit achievable by the application of control technology that is reasonably available considering technological and economic feasibility. It is determined on a case-by-case basis taking into account the impact of the source upon air quality, the availability of additional controls, the emission reduction to be achieved by additional controls, the impact of additional controls on air quality, and the capital and operating costs of the additional controls [WAC 173-403(45)].

The DSHS has requirements for the monitoring, control, and enforcement of airborne radionuclide emissions in WAC 402-80. Construction of new sources of radionuclide emissions or modifications to existing facilities that will significantly change potential radionuclide emissions or significantly change the dose equivalent to any member of the public require the use of best avail-

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(a) Telephone conversation between P. L. Hendrickson, PNL, and Linda Kral, EPA Region 10, January 26, 1988.

(b) Memorandum from Mary L. Walker, DOE Assistant Secretary for Environment, Safety and Health, to Michael J. Lawrence, Manager, Richland Operations Office, August 14, 1987.

able radionuclide control technology (BARCT)(WAC 402-80-070). BARCT means use of available technology that will provide the maximum degree of reduction of radionuclide emission taking into account energy, environmental, and cost factors.

The DSHS has several design requirements at WAC 402-80-080 that apply to facilities under its jurisdiction. The existing SSTs are apparently under its jurisdiction because all DOE sources of airborne radionuclides are to be registered with DSHS [WAC 402-80-060(b)]. The requirements include the following:

- Stack sampling, ambient air monitoring, or other testing may be required.
- The use of continuous monitoring equipment is encouraged. If continuous monitoring is not feasible or reasonable, alternative monitoring and reporting procedures will be established on an individual basis.
- The DSHS reserves the right to require special emission tests and to perform sampling with its own personnel. The facility owner may be required to provide a sampling platform and sampling ports.

The Benton-Franklin-Walla Walla Counties Air Pollution Control Authority can also require stack and/or ambient air monitoring.(a)

7.3 DOE AND DOE-RL ORDERS

DOE Orders are updated periodically to address evolving regulatory and technical requirements. To ensure that SST disposal options meet all relevant regulatory criteria at the time of implementation, compliance planning efforts must follow the current version of DOE Orders, but be cognizant of ongoing revision efforts. The following sections will describe the current versions of relevant DOE Orders.

7.3.1 DOE Order 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations, August 13, 1981

This Order, which cancelled DOE Order 5480.1 (5/5/80), contained 13 chapters that established DOE policies and requirements in a variety of areas.

(a) General Regulation 80-7, Section 400-120(i).

These chapters have now been redesignated as separate Orders by DOE Order 5480.1B. However, until the new Orders are promulgated, the individual chapters of 5480.1A remain in effect, even though the Order itself (5480.1A) has been cancelled.

Chapters XI and XII of 5480.1A are relevant to SST waste management and are discussed in subsequent sections.

7.3.2 DOE Order 5480.1B, Environment, Safety, and Health Protection Program for DOE Operations, September 23, 1986 as updated by DOE Order 5480.1B, Change 1, February 18, 1988

[Attachment 1 of this Order redesignates the chapters of DOE Order 5480.1A into new Orders. The Order itself outlines general DOE environmental policies as well as the responsibilities of various DOE officials.]

This Order states that it is DOE policy to:

- assure the protection of the environment and the health and safety of the public
- assure safe and healthful workplaces and conditions of employment for all employees of DOE and DOE contractors
- assure compliance with applicable statutory requirements affecting federal facilities and operations
- reduce environment, safety, and health risks, even if not mandated by specific requirements.

The remaining sections of the Order are devoted to outlining the responsibilities and authorities of various organizations and officials.

7.3.3 DOE Order 5480.11, Radiation Protection for Occupational Workers, December 21, 1988

[This Order supercedes the occupational radiation protection standards in DOE 5480.1A, Chapter XI. Draft DOE 5400.xx will replace the individual and environmental radiation protection standards when finalized (as DOE 5400.3).]

This Order establishes occupational radiation protection standards for DOE and DOE contractor operations. The Order includes radiation protection

standards for internal and external exposure of operational workers, including standards for exposure of the unborn child; for occupational exposure of minors and students; for planned special exposures; and for exposure of members of the public entering a DOE controlled area. It is DOE policy to maintain radiation exposures within the limits of the Order and as far below these limits as is reasonably achievable.

In general, the annual effective dose equivalent from both internal and external sources received in any year by an occupational worker must not exceed 5 rem. The effective dose equivalent received in any year must not exceed 15 rem to the lens of the eye or 50 rem to any other organ, tissue (including the skin of the whole body), or extremity. The total dose equivalent received by the unborn child over the period of gestation as a result of occupational exposure of a female worker (who has notified her employer in writing of her pregnancy) must not exceed 0.5 rem.

In addition to the above dose limits, the Order contains air and water concentration guides for radionuclides. Derived air concentrations (DACs) for limiting radiation exposures due to inhalation of radionuclides are given in Attachment 1 to the Order. For water, concentrations of radionuclides in drinking water in controlled areas must not exceed the standards given in 40 CFR 141. The Order also contains guidance on calculating internal and external doses and on keeping records of such exposure.

7.3.4 DOE-RL Order 5480.11A, Requirements for Radiation Protection, September 17, 1986

This Order supplements the occupational radiation protection requirements previously contained in Chapter XI of DOE Order 5480.1A. The Order provides additional requirements for protecting against occupationally-related exposures to individuals in controlled areas.

7.3.5 DOE Order 5490.1A, Chapter XI, Requirements for Radiation Protection, August 13, 1981, as updated by DOE Order 5480.1, Change 6, August 13, 1981

[The occupational radiation standard in DOE Order 5480.1A, Chapter XI, was replaced by DOE Order 5480.11. The individual and environmental radiation protection standards will be replaced by DOE Order 5400.3 when it is finalized.]

The exposure standards for protection of the public in Chapter XI were replaced in 1985 by new standards in a DOE Memorandum to Field Offices (DOE 1987). The maximum radiation exposure for any member of the public from all routine DOE operations must be as low as is reasonably achievable. The effective dose equivalent for occasional exposure (5 years or less) must not exceed 500 mrem/yr. For a prolonged exposure period (greater than 5 years), the effective dose equivalent must not exceed 100 mrem/yr. Also, no member of the public may receive an annual dose equivalent in excess of 5000 mrem/yr to an individual organ of the body.

7.3.6 DOE Order 5480.1A, Chapter XII, Prevention, Control and Abatement of Environmental Pollution, August 13, 1980

[This Chapter was initially issued in Change 1 of DOE Order 5480.1 (12/18/80). Draft DOE Order 5480.12, when finalized, will replace the Order.]

Chapter XII of DOE Order 5480.1A establishes general environmental protection requirements for DOE operations that assure both control of sources of environmental pollution and compliance with federal environmental protection laws as well as federal, state and local pollution control standards. These requirements, which could impact the SST program, include:

- Performance of design, development, construction, operation, surveillance, and maintenance of DOE facilities and activities so as to assure protection of the environment.
- Submission of pollution abatement plans for projects that upgrade existing DOE operations to achieve compliance with applicable pollution control standards and requirements found in Section 1-102 of Executive Order 12088.
- Controlling the use, storage, and handling of potential pollutants to avoid or minimize the possibility of accidental release to the environment. This includes the development of emergency plans and procedures for

containing, diverting, removing, or other measures necessary to deal with accidental pollution.

- Controlling the discharge of radioactivity to the environment to ALARA levels in accordance with Chapter XI of this Order (Requirements for Radiation Protection).

Draft DOE Order 5480.12, General Environmental Protection, Safety and Health Program for DOE Operations, (May 8, 1987), when finalized, will replace Chapter XII of DOE Order 5480.1B. In addition, this draft order has proposed to adopt the environmental standards requirement from DOE Order 5480.4 and the environmental reporting requirements from DOE Order 5484.1.

7.3.7 DOE Order 5480.4, Environmental Protection, Safety and Health Protection Standards, May 15, 1984 - as updated by DOE 5480.4, Change 1, May 16, 1988.

[This Order was formerly Chapter 1 of DOE Order 5480.1A, August 13, 1981].

This Order specifies mandatory and reference environmental protection, safety, and health (ES&H) standards for all DOE and DOE contractor operations. The identified standards are relevant and applicable to SST disposal decisions since this order must be followed during facility design, construction, modification, and decommissioning.

Standards within this Order have been organized into three categories and placed into separate attachments.

- Attachment 1 contains ES&H standards that are mandatory as a result of non-DOE federal or state statutes and/or implementing regulations. These standards include the CWA, RCRA, CAA, SDWA, CERCLA, and other statutes and regulations which may impact SST disposal.

- Attachment 2 contains ES&H standards that are mandatory as a matter of DOE policy. Included in this attachment are regulations for environmental protection, occupational safety, and others.

- Attachment 3 contains ES&H standards and guidelines that are not mandatory, but useful as references for good practices and ES&H information.

DOE RL 5480.4A Environmental Protection, Safety, and Health Protection Standards for RL, December 1, 1987

DOE-RL issued this Order to supplement DOE Order 5480.4 of May 15, 1984. This Order contains additional mandatory and recommended standards. The environment protection standards that are listed as mandatory include 40 CFR 280, "Underground Storage Tanks"; WAC 173-303, "Dangerous Waste Regulations"; and 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan"; and 40 CFR 302, "Designation, Reportable Quantities and Notification."

7.3.8 DOE Order 5481.1B, Safety Analysis and Review System, September 23, 1986 - as updated by DOE Order 5481.1B, Change 1, May 19, 1987

The basic requirements of Chapter 1 of DOE Order 5481.1B are to establish requirements for the preparation and review of a safety analysis which is to be initiated during the earliest phase of a DOE operation to facilitate early hazard identification, assessment and the subsequent elimination or control. This safety analysis and review will be provided by the organization with immediate operating responsibility and will:

- identify and demonstrate conformance with applicable guides, codes, and standards
- demonstrate that there is reasonable assurance that the DOE operation can be conducted in a manner that limits risk to the health and safety of the public employees, and protects the environment.

The Order also contains requirements for evaluating onsite or offsite impacts to people or the environment resulting from ongoing DOE operations. Ongoing DOE operations must have available documentation (based upon current technical criteria) that identifies the risk involved. When hazards are identified that can be eliminated, controlled, or mitigated through reasonable measures, the appropriate upgrading actions must be identified and implemented.

Chapter 2 of this Order presents guidance and recommendation for use in implementing the Order. A description of the contents that must be included in a safety analysis is also provided in the Order.

DOE-RL Order 5481.1, Safety Analysis and Review System, October 5, 1983

This Order supplements DOE Order 5481.1B with Hanford-Site-specific administrative requirements for safety analyses.

7.3.9 DOE Order 5820.2A, Radioactive Waste Management, September 26, 1988

This Order contains policies and guidelines for the management and disposal of DOE's radioactive and radioactive mixed wastes, including HLW, LLW, and TRU wastes. The overall objective of the Order is to ensure that all DOE operations conducted pursuant to the AEA provide adequate protection of the public health and safety, and are in accordance with the radiation protection standards specified in DOE Orders.

High-Level Waste

Unless demonstrated to the contrary, all HLW will be considered to be radioactive mixed waste and subject to the requirements of the AEA and RCRA. The HLW management policy is that such waste shall be safely stored, treated, and disposed of in accordance with the requirements of this Order. Storage operations will comply with applicable EPA standards and EPA/state regulations. Geologic disposal of HLW will comply with both NRC regulations and EPA standards.

Design objectives for new HLW facilities must assure protection of the public and operating personnel from hazards associated with normal operations, accident conditions, and the effects of natural phenomena. Designs for new storage facilities must facilitate retrieval, and new storage and treatment facilities must meet the requirements of DOE Order 6480.1, 40 CFR 264, and applicable DOE environment, safety, and health (EH) Orders.

Wastes stored in singly contained tank systems (such as SSTs) must be characterized consistent with radiation protection requirements and safe storage needs to determine their hazardous components consistent with 40 CFR 261, 40 CFR 264, and state requirements. Characterization may reflect knowledge of waste generating processes, laboratory testing results, and periodic sampling and analysis.

Storage and transfer operations for wastes stored in singly contained tank systems will be conducted in accordance with the Safety Analysis Reports according to DOE Order 5841.1B. Engineered systems, such as surface level sensing devices and interstitial liquid level sensing devices, will be incorporated to provide waste volume inventory data. Singly contained pipelines may be used routinely for liquid waste that has a total radioactivity concentration of less than 0.05 Ci/gal, and may be used temporarily for higher activity waste if design and administrative controls are in place to mitigate adverse effects from a pipeline failure.

If active ventilation of singly contained tank systems is required, radiation releases at the point of discharge will be maintained within the guidelines specified in applicable DOE Orders for offsite concentrations and DOE Order 5480.1B for onsite doses. Remote maintenance features and other appropriate techniques will be used to maintain personnel radiation exposure as low as is reasonably achievable.

For wastes stored in singly contained tank systems, monitoring and surveillance capability must exist to provide liquid volume data, waste inventory data, and identification of failed containment. A method for periodically assessing waste storage tank integrity (such as coupons, photographic inspections, leak detectors, or liquid level devices) must be established and documented.

New and readily retrievable HLW will be processed and the HLW fraction disposed of in a geologic repository in accordance with the NWPA. Such waste will be processed to a final immobilized form in facilities such as the Hanford Waste Vitrification Plant, and waste acceptance specifications and other criteria will be developed based on the requirements in 10 CFR 60.113, 10 CFR 60.131(b)(7), 10 CFR 60.135, 10 CFR 71.87, and 40 CFR 191. Options for permanent disposal of other waste, such as SST waste, will be evaluated; these options include such disposal methods as in-place stabilization as well as retrieval and processing (as required for new and readily retrievable waste). Analytic predictions of disposal system performance will be prepared and incorporated in the NEPA process. HLW that is not readily retrievable will

be monitored periodically in situ. The safety of such waste will be reevaluated as necessary to determine the need for corrective actions.

TRU Waste

Transuranic waste that is also mixed waste is subject to the requirements of the AEA and the RCRA. (In addition, buried TRU wastes are subject to the requirements of CERCLA.) Transuranic waste will be managed to protect the public and worker health and safety as well as the environment. Such management will comply with applicable radiation protection standards and environmental regulations.

Transuranic waste will be certified in compliance with the waste acceptance criteria for the Waste Isolation Pilot Plant (WIPP), placed in interim storage (if needed), and sent to the WIPP. Transuranic waste that cannot be approved for acceptance at the WIPP, or that does not require the degree of isolation provided by a geologic repository (as determined by the DOE and the EPA), will be disposed of by alternate methods. Such methods will comply with NEPA requirements and EPA/state regulations.

The lower concentration limit for TRU waste (>100 nCi of transuranic radionuclides per gram of waste) will apply to the contents of any single waste package at the time of assay. (The mass of the waste container, including shielding, will not be included in calculating the specific activity of the waste.) Radioactive wastes containing transuranic radionuclides in concentrations of 100 nCi/g of waste or less will be considered to be LLW.

Mixed TRU waste that meets WIPP acceptance criteria will be sent to WIPP for disposal. The determination of whether the TRU waste exhibits any hazardous characteristics or contains listed hazardous components may be based on a knowledge of the waste generating process when the performance of a chemical analysis would significantly increase the radiation hazard to personnel.

New facilities for interim storage of uncertified waste that is awaiting processing and certification will be sited, designed, constructed, and operated consistent with the requirements of applicable RCRA regulations and in a manner that addresses considerations such as proximity to groundwater, seismic activity, and flood plains; minimization of precipitation run-on and run-off;

environmental monitoring to detect any release and migration of major radioactive and hazardous components; minimization of personnel exposure to radiation and chemicals; closure plan requirements for sampling, testing, and monitoring; compliance with applicable RCRA requirements for sites that store TRU waste in underground storage tanks; and permit requirements for interim storage facility activities. Existing interim storage sites will be reviewed for consistency with these and other considerations; any necessary corrective action requirements will be performed on a compliance schedule approved by appropriate regulatory authorities.

Low-Level Waste

Low-level waste operations will be managed to protect the health and safety of the public, preserve the environment of the waste management facilities, and ensure that no legacy requiring remedial action remains after operations have been terminated. DOE LLW will be managed on a systematic basis using the most appropriate combination of waste generation reduction, segregation, treatment, and disposal practices to contain the radioactive components and to maximize the overall cost effectiveness of the system. Management of mixed LLW will conform to the requirements of this Order, applicable DOE Orders, and will also be regulated by the appropriate regional authorities under the RCRA.

DOE LLW that has not been disposed of prior to the issuance of this Order will be managed so as to accomplish the following performance objectives:

- protection of public health and safety in accordance with standards specified in applicable DOE Orders and other DOE Orders
- assurance that external exposure to the waste and to concentrations of radioactive material that may be released into surface water, groundwater, soil, plants, and animals results in an effective dose equivalent that does not exceed 25 mrem/yr to any member of the public. Releases to the atmosphere will meet the requirements of 40 CFR 61. Reasonable efforts should be made to maintain releases of radioactivity in effluents to the general environment ALARA.
- assurance that the committed effective dose equivalents received by individuals who may inadvertently intrude into the facility after the loss of institutional control (100 years) will not exceed 100 mrem/yr for continuous exposure of 500 mrem for a single acute exposure

- assurance that groundwater resources are protected consistent with federal, state, and local requirements.

Site-specific radiological performance assessments will be prepared for LLW waste disposal sites to demonstrate compliance with the above performance objectives. Where practical, monitoring to evaluate actual and prospective performance should be undertaken. Monitoring should also be used to validate or modify the models used in performance assessments.

Low-level waste will be characterized with sufficient accuracy to permit proper segregation, treatment, storage, and disposal. Waste characterization data will include information on the physical and chemical characteristics of the waste, the volume and weight of the waste, and the major radionuclides and their concentrations. Radionuclide concentrations may be determined by indirect methods if there is reasonable assurance that the indirect methods can be correlated with actual measurements. Indirect methods include the use of scaling factors that relate the inferred concentration of one radionuclide to another that is measured and the use of radionuclide material accountability data.

Low-level waste will be disposed of by methods appropriate to achieve the performance objectives described above. Engineered modifications (such as stabilization, packaging, burial depth, and barriers) for specific waste types and for specific waste compositions (such as fission products, induced radioactivity, uranium, thorium, and radium) for each disposal site will be developed through the performance assessment model. In the course of this process, site-specific waste classification limits may be developed if operationally useful in determining how specific wastes should be stabilized and packaged for disposal. Disposition of waste designated as GTCC, as defined in 10 CFR 61.55, must be handled as a special case. Disposal systems for such waste must be justified by a specific performance assessment through the NEPA process.

7.4 COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA)

The CERCLA response and cleanup authority applies to the release (or substantial threat thereof) of hazardous substances into the environment and the cleanup of inactive waste sites. The decisions associated with a CERCLA cleanup are documented in a record of decision that sets forth the negotiated performance and design criteria for the cleanup.

The CERCLA release and cleanup requirements are of interest for SST waste management in the long term for several reasons. First, as noted, CERCLA cleanup requirements are similar to the corrective action requirements in section 3004(u) of RCRA. Also, after litigation, some hazardous waste sites closed under RCRA have been re-opened for cleanup under CERCLA. In addition, spills that occur during SST waste retrieval, handling, and processing could trigger CERCLA reporting and cleanup requirements. Thus, waste management strategy development should take into account the possible future applicability of CERCLA to the SSTs. This section describes the performance and design requirements that may be imposed upon application of CERCLA to the SSTs. Finally, CERCLA cleanup provisions are also of interest because they may be applied to facilities, such as the cribs, associated with the SSTs.

7.4.1 Release

Table 302.4 under 40 CFR 302.4 lists a number of hazardous substances and their RQs. If a release of a hazardous substance from a facility is equal to or greater than its RQ, CERCLA requires immediate notification to the National Response Center (established under the CWA). The RQ for radionuclides is 1 lb under Section 102(b) of CERCLA. EPA recently recognized that this RQ may not be appropriate, because smaller quantities of radionuclides may present a substantial threat to public health, welfare, or the environment. Consequently, EPA has proposed a rule adjusting the RQs for individual radionuclides and listing these quantities in terms of curies rather than pounds (52 FR 8172; March 16, 1987).

7.4.2 Cleanup

The cleanup of releases under CERCLA involves removal actions and remedial actions. A removal action is generally a short-term, limited response (limited by time, money, etc.) to a more manageable problem. For example, following a surface spill, removal of the liquid plus the contaminated soil (for disposal elsewhere) leaving little or no contamination at the site would constitute a removal action. A remedial action is the endpoint of the Remedial Investigation/Feasibility Study (RI/FS) process and is generally a longer term, more expensive solution to a more complex problem. For example, a program designed to clean up an area at the surface as well as the groundwater would be a remedial action. This might involve subsurface barriers to prevent migration of hazardous substances. A removal action and/or a remedial action can occur separately and uniquely; however, they may also occur together if, for example, a removal action is necessary to facilitate a remedial action. The need for a removal action must be addressed during the RI/FS process or in a situation where there is an imminent threat to human health or the environment.

7.4.2.1 Remedial Actions

General performance requirements for remedial actions are found in CERCLA itself. While these are not accompanied by specific numerical criteria, reference is made to water quality standards that can provide a measure of compliance. These criteria are described below.

Section 104(c)(6) of CERCLA states:

> "... in the case of ground or surface water contamination, completed remedial action includes the completion of treatment or other measures, whether taken onsite or offsite, necessary to restore ground and surface water quality to a level that assures protection of human health and the environment."

General policy on the choice of a remedial action is given in section 121(b), which states:

> "... [remedial actions] in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, and contaminants is a principal

element, are to be preferred over remedial actions not involving such treatment."

Section 121(d) reiterates the general requirement to protect human health and the environment:

> "... [remedial actions] shall attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and of control of further release at a minimum which assures protection of human health and the environment."

Numerical criteria by which to assess compliance with the above standards are included by reference in section 121(d), which requires a standard of control (following the completion of a remedial action):

> "... which at least attains Maximum Contaminant Level Goals established under the Safe Drinking Water Act and water quality criteria established under section 304 or 303 of the Clean Water Act, where such goals or criteria are relevant and appropriate under the circumstances of the release or threatened release."

These standards are discussed further in Section 7.8.1 of this report.

Design requirements for remedial actions under this section consist of various methods to remediate hazardous substance releases. A listing of these methods is found at 40 CFR 300.70(b) under the following general headings: air emission controls, surface water controls, groundwater controls, contaminated water and sewer lines, gaseous emissions treatment, direct waste treatment (neutralization, incineration, etc.), and contaminated soils and sediment treatment.

7.4.2.2 Removal Actions

Removal actions can occur immediately in the event of an emergency, or may take place following a ROD. Performance criteria for removal actions are found in the implementing regulations as follows:

> "Any release, regardless of whether the site is included on the National Priorities List, where the lead agency (usually EPA) determines that there is a threat to public health or welfare or the environment, must be abated, minimized, stabilized, mitigated, or eliminated" [40 CFR 300.65(b)(1)]. The lead agency may also take action on the threat of a release.

"If the lead agency determines that a removal action is appropriate, actions shall begin as soon as possible to prevent, minimize, or mitigate the threat to public health or welfare or the environment [40 CFR 300.65(b)(4)]."

Removal actions shall, to the greatest extent possible, attain or exceed applicable relevant and appropriate federal public health and environmental requirements [40 CFR 300.65(f)].

The design requirements under this section deal with the design of appropriate removal actions after a release of hazardous substances has occurred. 40 CFR 300.65(c) contains a list of approved removal actions that includes:

- fences, warning signs, or other security or site control precautions
- drainage controls
- stabilization of berms, dikes, or impoundments
- capping of contaminated soils or sludges to reduce the migration of pollutants, contaminants, and hazardous substances into soil, groundwater, or air
- use of chemicals and other materials to retard the spread of a release or to mitigate its effects
- removal of highly contaminated soils
- removal of containers holding pollutants, contaminants, or hazardous substances to reduce the likelihood of spillage; leakage; exposure to humans, animals, or the food chain; or fire or explosion
- provision of an alternative water supply to reduce the likelihood of exposure of humans or animals to contaminated water.

7.5 EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT (EPCRA)

While EPCRA does not contain performance or design requirements, it does specify RQs and reporting requirements for EPCRA-defined extremely hazardous substances and CERCLA-defined hazardous substances. The RQs are based on the CWA RQs discussed in Section 7.6 of this report. In the absence of numerical criteria on particular SST waste constituents, the RQs for these constituents may be used to develop criteria for use in performance assessments for a SST in-place disposal system. For example, the RQs may be used to assess the

relative regulatory importance of SST chemicals when other indicators do not exist.

7.6 NUCLEAR WASTE POLICY ACT OF 1982 (NWPA) IMPLEMENTING REGULATIONS

The NRC regulations implementing the NWPA are applicable to radioactive waste management and disposal facilities regulated by the NRC (and Agreement States). (As described in previous chapters, portions of these regulations, or variants thereof, may be applicable to DOE facilities under the ERA). The EPA environmental protection standards for radioactive waste management and disposal are applicable to NRC-regulated facilities and to facilities operated by the DOE without NRC regulation. Thus, to the extent that the SST wastes are disposed of in place, the EPA environmental protection standards for HLW, TRU waste, or LLW may be applicable to disposal system design and evaluation.

7.6.1 40 CFR 191, Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes

As discussed in Section 4.5.1, portions of 40 CFR 191 were vacated and remanded to EPA for further review in July 1987. The Court's ruling includes a finding that the EPA had not adequately explained or reconciled the difference between the 25 mrem/yr individual dose limit for all pathways and the 4 mrem/yr limit for the drinking water pathway that forms the basis for the MCLs under the SDWA. The groundwater protection requirements are currently being reviewed by EPA. The unmodified regulations are discussed below.

Preclosure Performance Criteria

Subpart A of 40 CFR 191 requires that the management and storage of spent nuclear fuel or HLW or TRU wastes be conducted in such a manner as to provide reasonable assurance that the combined annual dose equivalent to any member of the public in the general environment resulting from discharges of radioactive material and direct radiation from such management and storage shall not exceed:

- 25 millirems to the whole body

- for facilities regulated by the NRC or Agreement States, 75 millirems to the thyroid and 25 millirems to any other critical organ
- for disposal facilities operated by the DOE and not regulated by the NRC or Agreement States, 75 millirems to any critical organ.

The EPA is authorized to issue alternative standards for facilities not regulated by the NRC or Agreement States if such standards will prevent any member of the public from receiving: 1) a continuous exposure of more than 100 millirems per year dose equivalent and 2) an infrequent exposure of more than 500 millirems dose equivalent in a year from all sources, excluding natural background and medical procedures (40 CFR 191.04).

Postclosure Performance Criteria

Subpart B of 40 CFR 191 currently requires that disposal systems be designed to provide a reasonable expectation, based upon performance assessments, that the cumulative releases of radionuclides to the accessible environment for 10,000 years after disposal from all significant processes and events that may affect the disposal system shall have a likelihood of less than one chance in 10 of exceeding the quantities calculated according to Table A.9, and have a likelihood of less than one chance in 1000 of exceeding 10 times those quantities [40 CFR 191.13(a)]. Performance assessments need not provide complete assurance that the requirements of 191.13(a) will be met because of the uncertainties in projecting disposal system performance. What is required is a reasonable expectation, on the basis of the record before the implementing agency, that compliance will be achieved [40 CFR 191.13(b)].

The individual protection requirements of Subpart B state that disposal systems shall be designed to provide a reasonable expectation that, for 1000 years after disposal, undisturbed performance of the disposal system shall not cause the annual dose equivalent from the disposal system to any member of the public in the accessible environment to exceed 25 millirems to the whole body or 75 millirems to any critical organ. All potential pathways (associated with undisturbed performance) from the disposal system to people shall be considered, including the assumption that individuals consume 2 liters

per day of drinking water from any significant source of groundwater[a] outside of the controlled area (40 CFR 191.15).

The groundwater protection requirements of Subpart B state that disposal systems shall be designed to provide a reasonable expectation that, for 1000 years after disposal, undisturbed performance of the disposal system shall not cause the radionuclide concentrations averaged over any year in water withdrawn from any portion of a special source of groundwater[a] to exceed:

- 5 picocuries per liter of ^{226}Ra and ^{228}Ra
- 15 picocuries per liter of alpha-emitting radionuclides (including ^{226}Ra and ^{228}Ra but excluding radon)
- the combined concentrations of radionuclides that emit either beta or gamma radiation that would produce an annual dose equivalent to the total body or any internal organ greater than 4 millirems per year if an individual consumed 2 liters per day of drinking water from such a source of groundwater.

If any of the average annual radionuclide concentrations existing in a special source of groundwater before construction of the disposal system already exceed the above limits, the disposal system shall be designed to provide a reasonable expectation that, for 1000 years after disposal, undisturbed performance of the disposal system shall not increase the existing average annual radionuclide concentrations in water withdrawn from that special source of groundwater by more than the limits established above.

Assurance Requirements

Section 191.14 sets out requirements meant to assure long-term compliance with the performance requirements of Section 191.13 for facilities not regulated by the NRC. (Comparable provisions applicable to facilities regulated by the NRC are given in 10 CFR 60.) These requirements state that waste disposal will be conducted in accordance with the following provisions:

(a) In the HDW-EIS, the DOE states, "Although groundwater beneath the Hanford Site is considered a 'significant' source of groundwater according to 40 CFR 191.12(n), there is no withdrawal of that groundwater for purposes of supplying any community water systems. There are no 'special' sources of groundwater as defined in 40 CFR 191.12(o) in the vicinity of the Hanford Site (DOE 1987)."

- Active institutional controls over disposal sites should be maintained for as long a period of time as is practicable after disposal; however, performance assessments that assess isolation of the wastes from the accessible environment shall not consider any contributions from active institutional controls for more than 100 years after disposal. Active institutional control means controlling access to a site by means other than passive institutional controls, performing maintenance operations or remedial actions, controlling or cleaning up releases from a site, or monitoring parameters related to disposal system performance [40 CFR 191.12(f)].

- Disposal systems shall be monitored after disposal to detect substantial and detrimental deviations from expected performance. This monitoring shall be done with techniques that do not jeopardize the isolation of the wastes and shall be conducted until there are no significant concerns to be addressed by further monitoring.

- Disposal sites shall be designated by the most permanent markers, records, and other passive institutional controls practicable to indicate the dangers of the wastes and their location.

- Disposal systems shall use different types of barriers to isolate the wastes from the accessible environment. Both engineered and natural barriers shall be included.

- Places where there has been mining for resources, or where there is a reasonable expectation of exploration for scarce or easily accessible resources, or where there is a significant concentration of any material that is not widely available from other sources, should be avoided in selecting disposal sites unless the favorable characteristics of such places compensate for their greater likelihood of being disturbed in the future. Resources to be considered shall include minerals, petroleum or natural gas, valuable geologic formations, and groundwaters that are irreplaceable because there is no reasonable alternative source of drinking water available for substantial populations or that are vital to the preservation of unique and sensitive ecosystems.

- Disposal systems shall be selected so that removal of most of the wastes is not precluded for a reasonable period of time after disposal.

7.6.2 10 CFR 60 (Disposal of High-Level Radioactive Wastes in Geologic Repositories)

The performance criteria in 10 CFR 60 may provide useful guidelines for assessing success in protecting public health and the environment, whether or not NRC licensing of facilities is required in the final SST waste management plan.

Specific performance objectives in 10 CFR 60, Disposal of High-Level Wastes in Geologic Repositories, include the following:

- Through permanent closure, radiation exposures, levels, and releases shall be maintained within the 10 CFR 20 limits and applicable EPA limits.
- Following permanent closure, HLW will be substantially contained within the waste packages for at least 300 years.
- Pre-waste emplacement groundwater travel time shall be at least 1000 years.

7.7 LOW-LEVEL RADIOACTIVE WASTE POLICY ACT IMPLEMENTING REGULATIONS

The NRC regulations implementing the LLRWPA (as amended) set forth the procedures, criteria, and terms and conditions upon which the NRC issues licenses for the land disposal of LLW containing byproduct, source, and special nuclear material. The proposed EPA LLW standards will be applicable to the management, storage, and disposal of LLW at all NRC-licensed or DOE-authorized LLW disposal sites.

7.7.1 40 CFR 193, Environmental Standards for the Management, Storage, and Land Disposal of Radioactive Waste

As discussed in Section 4.5.2, the 40 CFR 193 standards (which apply to LLW management systems) are currently under development. The preliminary draft standards will probably be modified following the agency and public comment periods. The preliminary version of the standards is discussed below.

Individual Protection Requirements

Subpart A of the proposed 40 CFR 193 regulations requires that the management and storage of LLW at all LLW disposal sites and at the all DOE facilities be conducted in such a manner that combined, no member of the public in the general environment shall receive an annual effective whole body dose equivalent of more than 25 millirems for all routes of exposure caused by such management and storage.

Subpart B of the proposed regulations requires that the disposal of all LLW be conducted in such a manner that combined, no member of the public in the general environment shall receive an annual effective whole body dose

equivalent of more than 25 millirems from all routes of exposure. Subpart B also sets out implementation requirements that are similar to some of the 40 CFR 191 assurance requirements. In particular, the implementation requirements repeat the 40 CFR 191 requirement that performance assessments not consider the contribution of active institutional controls for more than 100 years after disposal. The Subpart A and B requirements as drafted would apply immediately to all new NRC licensed and DOE management, storage, and disposal facilities. The requirements would apply to existing NRC facilities at the time of relicensing, and to existing DOE facilities 3 years from the effective date of the rule.(a)

Groundwater Protection Requirements

Subpart C of the proposed regulations applies to the release of radionuclides into various classes of groundwater from any facility regulated by Subparts A or B. The Subpart C requirements would apply to the release of radionuclides into the groundwater from all NRC and DOE facilities regulated by Subparts A and B.

The groundwater protection standards require that the disposal of LLW cannot result in any increase in the levels of radioactivity for all Class I groundwaters, which are highly vulnerable to contamination and include irreplaceable sources of drinking water and groundwaters that are ecologically vital. For all high yield Class II groundwaters, which include aquifers that provide the primary source of water to communities, such disposal cannot result in any increase in radioactivity levels such that an individual can receive more than 4 millirems annual effective whole body dose equivalent by drinking 2 liters per day of affected groundwater. The level of radioactive contamination permitted in any groundwater that is hydrogeologically connected to another source of groundwater shall be determined by the class of groundwater to which it is hydrodynamically connected, taking into account the hydrodynamic characteristics of the connecting groundwater channel. When the groundwater

(a) The Subpart B requirements would apply to existing NRC and DOE disposal facilities only if they continue to accept radioactive waste.

sources are regulated at different levels of protection, Subpart C states that the most protective standard shall apply.

Wastes Below Regulatory Concern

Subpart A of the proposed regulations also contains criteria for use in determining which LLWs are below regulatory concern (BRC) and thus not required to be disposed of in regulated LLW disposal facilities meeting the Subpart B requirements. Any LLW having a sufficiently low concentration of radioactivity such that its disposal alone, or in combination with all other waste streams in the United States that have been classified as having BRC radioactivity levels, would not expose any member of the public to an annual effective whole body dose equivalent of more than 4 millirems in any one year may be classified as BRC by the NRC (or Agreement States) or the DOE. The proposed regulations require that BRC wastes be disposed of only in ways that are expressly permitted by the NRC or the DOE or in regulated LLW disposal facilities. It is also stated that the BRC provisions do not remove or reduce the management, storage, or disposal requirements of any other applicable federal, state, or local regulation governing any other toxic or hazardous property of BRC waste.

7.7.2 10 CFR 61, Licensing Requirements for Land Disposal of Radioactive Wastes

The performance objectives in 10 CFR 61 may provide useful guidelines for assessing success in protecting public health and the environment. Specific performance objectives in 10 CFR 61, Licensing Requirements for Land Disposal of Radioactive Waste, include the following:

- Concentrations of radioactive material released to the general environment in groundwater, surface water, air, soil, plants, or animals must not result in an annual dose exceeding an equivalent of 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public.
- Reasonable effort should be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable.
- Operations shall be conducted in compliance with the 10 CFR 20 radiation protection standards.

Requirements are also specified for monitoring, siting, intruder protection, and handling of Class A, Class B, and Class C LLW. These waste classes are described in Section 5.2.5 of this report. The regulations in 10 CFR 61 also provide tables that can be used to classify LLW based on the concentration of long-lived radionuclides (or their precursors) and short-lived radionuclides.

As discussed in Chapter 5, waste that is classified as GTCC generally is not acceptable for shallow-land disposal. However, disposal of GTCC waste using greater confinement disposal (GCD), which would provide a degree of isolation from the environment greater than that of shallow-land burial but less than that of geologic repository disposal, is contemplated in the NRC's ANPR on the definition of HLW. [The NPR on this topic does not preclude such disposal, although it requires that commercial GTCC waste be disposed of in geologic repositories to ensure that a disposal "home" is available for the waste (52 FR 17709, May 18, 1988)]. While the regulatory requirements in 10 CFR 61 apply to shallow-land burial, they may still prove useful criteria with which to measure of the degree of environmental protection provided by GCD of SST waste.

7.8 SAFE DRINKING WATER ACT (SDWA)

Regulations under the SDWA and state statutes apply to public water supplies, underground injection wells, sole source aquifers, and wellhead protection areas. Even though the drinking water regulations under the SDWA do not apply to the SSTs, these regulations provide numerical criteria that can be used to assess the groundwater protection performance of a proposed in-place disposal system for the SST wastes. RCRA contains such criteria for only a limited number of constituents (40 CFR 265, Appendix III).

7.8.1 Public Water Supplies

The SDWA's primary purpose is to ensure the availability of safe, high quality drinking water. The state specifies that public drinking water shall be obtained from the highest quality source feasible. To accomplish this,

each public water system must comply with national primary drinking water regulations (NPDWRs) set forth at 40 CFR 141 and WAC 248-54-175.

The NPDWRs set MCLs for radionuclides, organic and inorganic chemicals, bacteriological contaminants, and physical parameters in water supplied to ultimate users. Variances from NPDWRs may be granted if raw water sources cannot meet the prescribed MCLs after the best available technology and treatment techniques have been applied to the system [42 USC 1415(a)] and it can be shown that the health of persons will not be endangered. Exemptions may be granted for a public water system if the system cannot meet an MCL for reasons other than the nature of the raw water supply or cannot install a treatment technology specified by primary standards as long as the exemption will not result in an unreasonable risk to public health (Section 1416(a) SWDA). The State of Washington may grant a waiver as long as the safety or health of persons using the public water supply is not jeopardized (WAC 248-54-055).

The national secondary drinking water regulations (NSDWRs, set forth at 40 CFR 143) contain guidelines for controlling contaminants that primarily affect the aesthetic qualities relating to public acceptance of drinking water. Recently proposed State of Washington regulations (WAC 248-54-175) require that compliance with secondary standards be enforced based on DSHS discretion as the public interest warrants.

In addition to the above performance criteria, the regulations specify design and treatment requirements that must be met by public water systems. Water supplied by public water supply systems and the systems themselves are subject to conditions such as the MCLs and operating, monitoring, notification, and corrective action requirements. The regulations at 40 CFR 141 discuss:

- Maximum Contaminant Levels (Subpart B)
- Monitoring and Analytical Requirements (Subpart C)
- Reporting, Public Notification and Recordkeeping (Subpart D)
- Special Regulations, Including Monitoring Regulations and Prohibition on Lead Use (Subpart E)

- Maximum Contaminant Level Goals (Subpart F)
- National Revised Primary Drinking Water Regulations: Maximum Contaminant Levels (Subpart G, currently being developed).

7.8.2 Underground Injection Control Program

The implementing regulations of the UIC Program, designed to prevent endangerment (contamination) of USDWs, may be useful as criteria to evaluate groundwater protection performance. Other groundwater protection criteria that are to be established under the evolving Sole Source Aquifer and Wellhead Protection Programs (discussed in Sections 7.5.3 and 7.5.4) should also be considered before beginning waste disposal activities with the potential for contaminating a USDW. The 1986 SDWA amendments provide statutory guidance to the agencies (EPA and state) for developing these programs. It is anticipated that these programs may set forth additional performance and design criteria for protecting USDWs and potential USDWs. In addition, the interpretation of the definition of USDWs is evolving. The federal regulations contain provisions for exempting some aquifers from USDW designation. These aquifers are those that would otherwise qualify for protection but that "have no real potential to be used as drinking water sources" [40 CFR 144.1(g)]. However, in Washington, "All groundwaters are considered to be existing or potential underground sources of drinking water and no waters are exempted from protection. This protection applies to all groundwaters regardless of current use or quality."(a) The development of the federal and state Sole Source Aquifer and Wellhead Protection programs should be tracked to ensure that impacts on SST waste management strategies are identified.

Any underground injection well that causes or allows the movement of fluid into a USDW that may result in a violation of any primary drinking water standard under 40 CFR 141 or that may otherwise adversely affect the beneficial use of a USDW is prohibited. Certain injections that do not adversely affect a USDW may be authorized by a permit or by rule (42 USC 142(b) and

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(a) Letter from Larry Goldstein, WDOE, to Paul Krupin, DOE-RL, dated September 21, 1987.

WAC 173-218-010). No owner or operator will be authorized to construct, operate, maintain, convert, plug, abandon, or conduct any injection activity in a manner that allows the movement of fluid containing any contaminant into a USDW, if the presence of that contaminant may cause a violation of any primary drinking water regulation or may otherwise adversely affect the health of persons (40 CFR 144.12). When injection does not occur into, above, or beneath a USDW, a well or project may be authorized with less stringent requirements for construction, mechanical integrity, operation, monitoring, and reporting.

Specific design requirements for UIC wells are found in 40 CFR 146. In addition, conditions necessary to prevent and control injection of fluids into the waters of the state (WAC 173-218-030) will be specified in the UIC permit and will include:

- all known, available, and reasonable methods of prevention, control, and treatment
- applicable requirements as contained in 40 CFR 124, 144, and 146
- any conditions necessary to preserve and protect USDW.

7.8.3 Sole Source Aquifers

A sole source aquifer is an aquifer that is the sole or principal drinking water source for an area and that, if contaminated, would create a significant hazard to public health [42 USC 1424(e)]. Aquifer protection areas are created to protect, preserve and rehabilitate subterranean water (RCW 36.36). The programs and regulations to implement these statutes are currently under development. Guidance on definitions and on performance and design criteria will be contained in these regulations. According to an interim final rule (52 FR 23982; June 26, 1987), these resulting criteria will be based on such factors as hydrogeologic characteristics, size of the population using the groundwater as a source of drinking water, and benefits and costs of maintaining or degrading groundwater quality [42 USC 1427(d)].

Aquifers that are designated as sole source aquifers may be subject to additional aquifer protection requirements, which will be promulgated by the regulatory agencies (EPA and Ecology). In its administration of programs related to waste disposal and other practices that may impact water quality,

the Washington Water Resources Act of 1971 states that all possible measures for aquifer protection will be explored (RCW 90.54).

7.8.4 Wellhead Protection Areas

Wellhead areas, defined as the subsurface and surface areas surrounding a water well or wellfield, which supply a public water system are to be protected from contaminants that are reasonably likely to move toward and reach the water well or wellfield (42 USC 1428). The 1986 Amendments to the SDWA require each state to adopt and submit to EPA a state program to protect wellhead areas within its jurisdiction from contaminants. To assist states in developing these programs, EPA released Guidelines for Delineation of Wellhead Protection Areas (EPA 1987). Washington presently has requirements for establishing wellhead area boundaries, limiting sources of contamination within those boundaries and controlling land use in a particular area (WAC 248-54-125). However, additional requirements may be imposed in response to the 1986 amendment that will be based on the EPA Guidelines. The development of these regulations should be tracked as the wellhead protection program evolves.

7.8.5 EPA Groundwater Classfication Guidelines

In December of 1986, EPA released the final draft of "Guidelines for Groundwater Classifications under EPA Ground-Water Protection Strategy." A strategy has been proposed which will classify groundwater within a prescribed area around a facility or activity based upon the value, use, and vulnerability to contamination of the groundwater. The three classifications of groundwater, which will be afforded different levels of protection, are described below:

- Class I - Special groundwaters (unusually high value).
- Class II - Current and potential sources of drinking water and water having other beneficial uses.
- Class III - Groundwater not a potential source of drinking water and of limited potential use.

The proposed guidelines would establish a procedure for classifying groundwater site by site, rather than region or aquifer. For a facility or activity that may affect the underlying groundwater, a "classification review area" would be established for the area within a two-mile radius of facility

or activity. The area could be expanded or reduced on the basis of the prevailing hydrogeological conditions.

EPA's groundwater classification system may become a factor in determining the level of protection or remediation to be applied to CERCLA and RCRA sites. Since EPA has estimated that 83 to 94 percent of classification determinations will result in Class II designations (current and potential sources of drinking water), most groundwater within critical review areas may become subject to drinking water standards.

7.8.6 Federal Water Pollution Control Act (FWPCA)/Clean Water Act (CWA)

Regulatory standards under the CWA apply to navigable waters and are not applicable to the SSTs. However, they may be useful in developing criteria that may be used to assess the groundwater protection performance of an SST in-place disposal facility. These standards the include RQs and water quality standards that are discussed below.

The CWA prescribes many performance requirements through which the national goals (identified in Section 101(a); 33 USC 1251, et seq.) established for maintaining the integrity of the nation's (navigable) waters can be achieved. This discussion of the CWA performance requirements will be limited to those requirements that are most applicable to the SST project; criteria such as those prescribed for public treatment works, marine vessels, and research and development grants will not be described in this document. The overriding requirement prescribed by the Act is that, except as in compliance with the requirements of the Act, the discharge of any pollutant into navigable waters by any person is unlawful.

The Act also declares that there should be no discharges of oil or hazardous substances into or upon the navigable waters of the United States (Section 311(b)(1), 33 USC 1251 et seq.). Implementing regulations in 40 CFR 116 contain a list of hazardous substances (other than oil and its derivatives) that, when discharged in any quantity into or upon navigable waters of the U.S., present an imminent and substantial danger to the public health or welfare. Reportable quantities allowed for each substance are given in 40 CFR 117.

The state of Washington has not promulgated any hazardous substances listing under the Washington Water Pollution Control Act.

Section 301(f) of the CWA also states that it is unlawful to discharge any radiological, chemical, or biological warfare agent or HLW into navigable waters.

Under the CWA, discharges to navigable waters must be permitted under the NPDES program. The NPDES permit specifies effluent limitations, standards, and prohibitions and other factors, such as reporting and monitoring requirements, for each outfall.

Washington State prescribes effluent limitations, water quality standards, and other permit requirements in WAC 173-220-130 and -150. Monitoring, recording and reporting requirements for the permits are set forth at WAC 173-220-210. These requirements apply to waters of the state, which include groundwaters. In addition, Washington's Waste Discharge Program was developed to prevent and control the discharge of wastes into waters of the state such that water quality standards (WAC 173-201) are not violated (WAC 173-216-020).

8.0 REFERENCES

DOE. 1986. Draft Environmental Impact Statement for the Disposal of Hanford Defense High-Level, Transuranic, and Tank Waste. DOE/DEIS-0113, U.S. Department of Energy, Washington, D.C

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APPENDIX A

REGULATORY LIMITS ASSOCIATED WITH SST WASTE CONSTITUENTS

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REGULATORY LIMITS ASSOCIATED WITH SST WASTE CONSTITUENTS

Tables A.1 and A.2 provide information on the wastes thought to be present in the SSTs and the extent to which regulatory limits for these constituents exist in the regulations. Estimates of the average concentrations of the waste constituents are included in the tables. These estimates were obtained by assuming that the constituent quantities given in DOE (1987) are uniformly distributed in the SST wastes. (Total SST waste quantities were also obtained from DOE 1987). These estimates, which are presented as examples of the types of calculations that could be performed, are not intended to quantify the actual waste concentrations in individual SSTs, but merely to indicate the relative significance of each distinct constituent to aid in the development of a waste characterization program. The regulatory limits given in the table will be useful in determining which constituents must be tested to classify the wastes. For completeness, unregulated constituents that are listed in DOE (1987) are also included in Tables A.1 and A.2

TABLE A.1. Regulatory Limits Associated with SST Waste Constituents

Constituent	Concentration Averaged Over All SST Waste[b] (mg/L)	RCRA					CERCLA[a]	EPCRA
		WAC 173-303			40 CFR			
		Groundwater[c] (mg/L)	Extremely Hazardous Waste[d] (mg/L)	Dangerous Waste[d] (mg/L)	Groundwater[e] (mg/L)	EP Toxicity[f] (mg/L)	Reportable Quantities[g] (lb)	Threshold Planning Quantity[h] (lb)
Cd	30	0.01	>100	1-100	0.01	1.0	1.0	2
Cr	700	0.05	>500	5-500	0.05	5.0	1.0	2
Hg	6	0.002	>20	0.2-20	0.002	0.2	1.0	2
Ni	1×10^3	---------listed[i]----------			----listed[i]----		1.0	10,000
Cl	300	---[j]	---	---	---	---	10	100
F	6×10^3	---------listed[i]----------			----listed[i]----		10	500
Na	4×10^5	---	---	---	---	---	1.0	
NO_x	4×10^4	---	---	---	---	---	10	500
$NaNO_x$	5×10^4	---	---	---	---	---	100[k]	2[k]
NaOH	5×10^4	---	---	---	---	---	1000	2
Na_3PO_4	1×10^5	---	---	---	---	---	5000	2
Radionuclides							[l]	2

(a) The reportable quantities for Cl, $NaNO_2$, NaOH, and Na_3PO_4 under the CWA are the same as those given here for CERCLA (see Table A.2).
(b) See text and Table A.2 for derivation of these values.
(c) Table 1, WAC 173-303-645.
(d) EP Toxicity List, WAC 172-303-090.
(e) Table 1, 40 CFR 261.24.
(f) Table 1, 40 CFR 264.91.
(g) Table 302.4, 40 CFR 302.4.
(h) Appendices A and B, 40 CFR 355.
(i) The constituent is regulated but no specific quantity is given.
(j) No limit found in the regulations.
(k) Based on $NaNO_2$.
(l) Proposed rules.

TABLE A.2. Regulatory Limits Relevant to SST Wastes

Constituent	Concentration Averaged Over All SST Waste[a] (mg/L)	SDWA Maximum Contaminant Level (mg/L) Federal[b]	SDWA Maximum Contaminant Level (mg/L) State[c]	SDWA Maximum Contaminant Level Goal[d] (mg/L)	SDWA Secondary Maximum Contaminant Level[e] (mg/L)	CWA Reportable Quantities[f] (lbs)
Cd	30	0.01	0.01	---	---	1.0
Cr	700	0.05	0.05	---	---	1.0
Fe	5×10^3	---	---	---	0.3	---[g]
Hg	6	.002	.002	---	---	1.0
Mn	900	---	---	---	0.05	---
Na	4×10^5	---	(h)	---	---	10
Cl	300	---	---	---	250	10
F	6×10^3	4.0	2.0[i]	2.0	2.0	---
SO_4	1×10^4	---	---	---	250	---
NO_3	7×10^5	10.0[j]	10.0	---	---	---
$NaNO_x$	5×10^4	---	---	---	---	100[k]
NaOH	5×10^4	---	---	---	---	1000
Na_3PO_4	1×10^5	---	---	---	---	5000
Volatile Organic Chemicals						
Benzene	---	0.005	---	0	---	1000
Vinyl chloride	---	0.002	---	0	---	1.0
Carbon tetrachloride	---	0.005	---	0	---	5000
1,2-dichloroethane	---	0.005	---	0	---	5000
Trichloroethylene	---	0.005	---	0	---	5000
1,1 dichloroethylene	---	0.007	---	0.007	---	5000
1,1,1-trichloroethane	---	0.20	---	0.20	---	1.0
p-dichlorobenzene	---	0.075	---	0.75	---	100
Naturally Occurring Radioactivity		(40 CFR 141.15)	(WAC 248-54-175)			
Radium-226	---		3 pCi/L			
Combined Radium-226 and Radium-228	---	5 pCi/L	5 pCi/L			
Gross alpha activity	---	15 pCi/L (including radium-226, but excluding radon and uranium	15 pCi/L excluding uranium)			

TABLE A.2. (contd)

Constituent	Concentration Averaged Over All SST Waste[a] (mg/L)	SDWA				CWA
		Maximum Contaminant Level (mg/L)		Maximum Contaminant Level Goal[d] (mg/L)	Secondary Maximum Contaminant Level[e] (mg/L)	Reportable Quantities[f] (lbs)
		Federal[b]	State[c]			
Manmade Radioactivity						
The maximum contaminant level for beta particle and photon radioactivity from manmade radionuclides is that the average annual concentration shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 millirem/year. Compliance with the 4 millirem/year dose limitation may be assumed if the annual average concentration for gross beta activity, tritium, and strontium-90 are less than 50 pCi/L, 20,000 pCi/L, and 8 pCi/L, respectively, provided that if radionuclides are present, the sum of their annual dose equivalents to bone marrow shall not exceed 4 millirem/year.						
Other Chemical Constituents Found in the SST Waste[l]						
Al as $NaAlO_2$, $Al(OH)_3$ and Cancrinite						
Bi as $BiPO_4$						
Ca as $CaCO_3$						
Fe as $Fe(OH)_3$ and $Ni_2Fe(N)_6$						
Mn as MnO_2						
Na as $NaNO_3$, Na_2CO_3, $NaAlO_2$, Na_2SO_4, and Cancrinate						
Zr as $ZrO_2 \cdot 2H_2$)						
Organic Carbon						
H_2O						

(a) Values of average concentration of constituents in SST waste were calculated by dividing the estimated total masses of the constituents by the estimated total volume of waste in the SST 5. Data used for these calculations were taken from Table A-3 of the Final Environmental Impact Statement, Disposal of Hanford Defense High-Level, Transuranic, and Tank Wastes (DOE 1987). The values calculated are the averages for the entire SST system and do not represent the concentrations of any individual tank.
(b) 40 CFR 141.11.
(c) WAC 248-54-175.
(d) 40 CFR 141.50. The state has not yet promulgated MCLs/MCLGs for volatile organic chemicals or a MCLG for fluoride in response to the 1986 SDWA amendments.
(e) 40 CFR 143.3.
(f) Table 117.3, 40 CFR 117.3.
(g) Iron compounds listed at 40 CFR 302 (Table 302.4). No reportable quantity for the element, Fe.
(h) No MCL has been established for sodium, however, there is enough public health significance connected with sodium levels to require inclusion in inorganic and physical monitoring programs [WAC 248-54-165(3)(a)(i)]. Information on sodium levels in drinking water should be provided to physicians needing these results to treat persons on sodium-restricted diets.
(i) State of Washington draft of proposed public water supplies regulations (WAC 248-54) prescribes a fluoride MCL of 4.0 mg/L - a change from present 2.0 mg/L. Federal requirement is 4.0 mg/L [40 CFR 141.11(c)].
(j) In the federal regulations only, nitrate levels not to exceed 20 mg/L may be allowed in a non-community water system, at the discretion of the state if criteria in 40 CFR 141.11(d)(1-4) are met.
(k) Based on $NaNO_2$.
(l) No limits found in regulations or DOE (1987).